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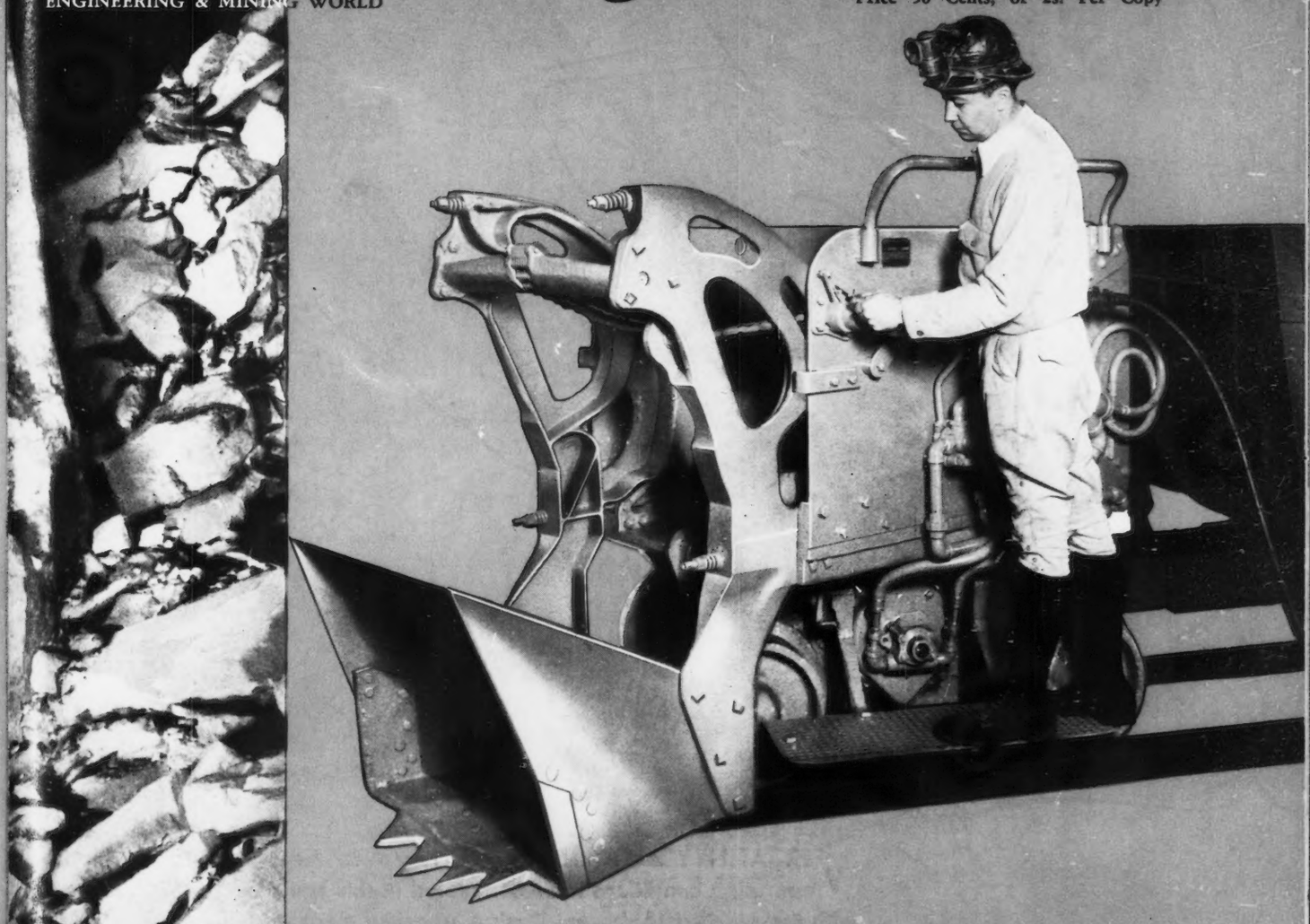

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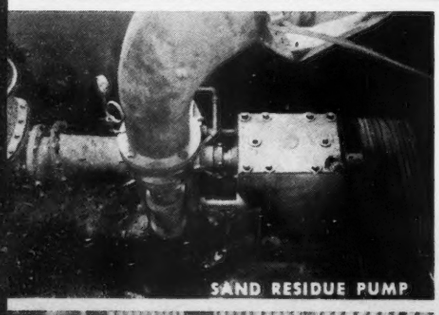
SLIME TAILINGS PUM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Engineering and Mining Journal

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Diesel Anniversary. Forty years ago Diesel power was first introduced into the United States. Today about 9,000,000 hp. is installed in this country. This tremendous development was made the occasion for honoring the memory of Dr. Rudolf Diesel at a luncheon in New York City during the Exposition of Power and Mechanical Engineering in December.

✠

Mechanical Ingenuity, as well as metallurgical skill, shines brightly in the Teck-Hughes cyanide plant at Kirkland Lake, now treating 1,000 tons per day. Present practice will be described in January by E. H. Whitman, mill superintendent. Emphasis will be laid on the numerous useful operating ideas that have been put to work.

✠

Style Comes First. In Singapore the natives known as Tamils use mosquito nets for protection against malaria, a precaution which is very necessary. The experience on most of the estates where netting is given free has been to see the natives appear in larger-sized turbans.

✠

Blue Ores of the Black Hills, formed by replacement of Cambrian dolomite, accompanied by silicification and pyritization, rarely yield as high an extraction of their gold, even where oxidized, as is generally realized. Roasting followed by direct cyanidation is the treatment given them at the Maitland mine, operated by the Canyon Corporation, of Deadwood, S. D. L. B. Eames and Roy Van Zante will tell the story of the work in an early issue.

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Platinum in the form of the rare mineral sperrylite has been found in Canada, and United States, and South Africa. Part of a large platinum deposit recently discovered on the Tweefontein farm, in the Transvaal, contained perfect sperrylite crystals as wide as 1.7 cm. This is thought to be the largest ever found.

✠

A "Chrome-Steel Ledge" on a mountain in Trinity County, Calif., is reported to be under investigation by engineers representing a leading automobile manufacturer. At depth a Fisher Body deposit may become metamorphosed into a license with full insurance coverage.

✠

Dust Prevention. A mixture of water with a little castor oil, projected as a fine spray, has been found most successful in rapidly dispersing dust and fume resulting from shot-firing at some of the iron ore mines in England, according to the 1935 report of the Chief Inspector of Mines and Quarries.

✠

New Sinking Record. Vlakfontein Gold Mining Company Ltd., in the Transvaal, established a new record in shaft sinking, at Vlakfontein No. 1 shaft last March, the total depth for the month being 422 ft. The previous record was 420 ft., made by West Rand Consolidated in May, 1932.

✠

Cats and Rats have their uses in places underground, as every reader may not know. The cats curb the rats and the rats support the cats, and both tend to make the miner less lonesome. This recalls the mine, once infested with black rodents but subsequently with black and white, after a Cousin Jack had brought his pet white rat on shift for company.

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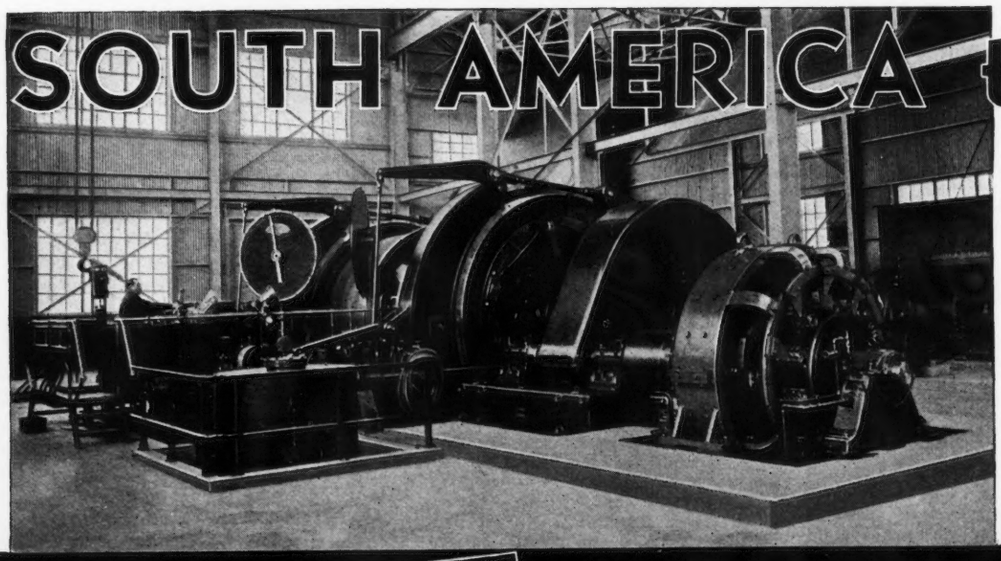

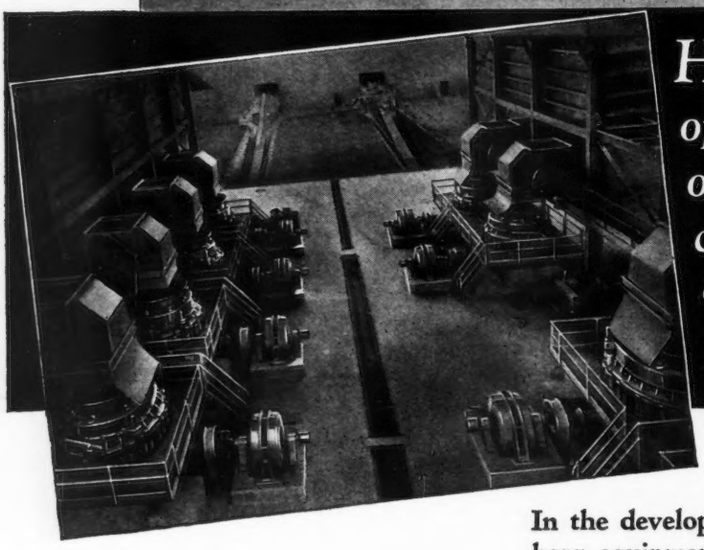

Hoisting and Crushing operations here as with most of the larger metal mining companies throughout the world are entrusted to Nordberg equipment. . . .

UPPER. The large double drum ore hoist in the foreground, and the smaller material hoist in the rear, are but two of the sixteen electric hoists built for Cerro de Pasco for their copper mining operations in Peru.

LOWER. These eight Symons Cone Crushers of seven-foot size are installed in Chile and are crushing nitrate. This is one of the largest crushing plants in the world.

In the development of all major mining fields, Nordberg equipment has had an important part. Among deep mines in particular, or where unusual hoisting problems are encountered, the choice of Nordberg Hoists for this important operation is evidence of the position they hold among mining executives.

With the growing tendency toward the attainment of finer crushing in greater quantity and at lower crushing costs, the Symons Cone Crusher has demonstrated by performance in hundreds of installations, its ability to meet these objectives. A growing demand for even still finer crushing is now being accomplished by the Short Head Cone. Within but a few years this machine has received wide-spread recognition among larger mine crushing plants where the trend is to secure as finely a crushed product as possible.

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Volume 137 DECEMBER 1936 Number 12

Politics and Business

WITH the national election in the background an attempt may be made to appraise its consequences in the immediate future. It now seems clear that the winning side shrewdly interpreted the popular mind as being far more interested in social than in economic issues. It is also evident that the majority of the voters responded normally to benefits already received and to the hope and expectation of more to come. In the light of events we may, therefore, look forward to a national administration that will probably be liberal, certainly not conservative. True, the President was vague during the campaign about his future policies, but there is no reason to believe that he has changed his general program, or that he will fail to interpret the election as a mandate to press his ideas for social betterment and correction of business practices that he considers against public policy.

In the field of legislation in 1937 Labor will be in the front line of activity. Having supported the New Deal with dollars and votes, it will not hesitate to demand its reward in the form of laws favorable to its economic and social aims. And this in spite of the internal strife that now marks the relations of the Green and Lewis factions. Both have announced their legislative plans and have authorized their leaders to press their programs to enactment. Higher wages, shorter hours, social security, collective bargaining, and better living conditions will be sought vigorously.

Nor is this all. Labor has already protested against the employee paying his share of the old-age pension under the Social Security Act, and may seek an amendment that will throw the whole burden on the employer. Furthermore, responding to the encouragement they have received from the Administration, labor organizations will push their plans to unionize industry, and may be expected to use the strike as a weapon to that end. Finally, efforts probably will be made to achieve the original objectives of N.R.A. and some of the other New Deal policies.

In the face of these political influences, what is the outlook for business in the next twelve months? Fortunately, the economic aspects are favorable. Business recovery has acquired a momentum that is strong enough to continue in spite of occasional political shocks. Capital-goods industries have only begun their march toward recovery. Plants are now being modernized. Obsolete equipment is being replaced. Residential building is getting under way. In short, the deficiencies of depression years are being made up, and a wave of "necessity buying" is sweeping over the country. Deferred demand for industrial products is making itself felt, and the outlook for manufacturing industry is most encouraging. For the mining industry this means increased consumption of metals, which has been in evidence for some months past. Other favorable aspects of the situation are greater stability of employment and increased mass purchasing power. Recent weeks have witnessed a wave of wage increases, bonuses, and dividends. These benefits may amount to as much as four billion dollars in 1937 and will greatly stimulate buying. The buoyant effect will be cumulative. It is an important part of the momentum that seems sure to make for much better business in 1937 in spite of uncertain political factors.

Fantastic Bait for Suckers

THE SECRET IS OUT. Mr. Bean of Los Angeles tells all. Perhaps you have often wondered why your ore assayed so low in gold, why some good looking rock was actually barren. And in the depths of discouragement you may even have wondered whether, after all, there wasn't something in the faker's claim to recover more gold than the fire assay shows. If so, listen intently to Mr. Bean, who brings the light of science to bear on the dark problem. Cosmic rays are the culprits. Throughout the ages they have been bombarding the Earth and have literally hammered to pieces the gold molecules and atoms of once-rich ores, until the gold is no longer recognizable or recoverable by ordinary means. Obviously, no mere fire assay could be expected to cope with an elusive split atom. So this ingenious scientist thwarts Nature by devising an "electrochemical catylectic" process of restoring split gold atoms to their normal state so that they can be recovered. How? With one of Mr. Bean's Superior Gold Recovery Machines, of course, and by the use of "tetra-brom-oxy-mercuri-fluorescein."

If you are on Mr. Bean's correspondence list you have received "a remarkable letter—possibly the most startling letter you have ever received." Two of them have been forwarded to us by thoughtful and outraged subscribers. The recipient is gently initiated into the mysteries of the cosmic-ray split-atom theory and the restoration process. He is then offered an opportunity to acquire on a 50-50 royalty basis one of five (only five, mind you) machine units at the introductory price of $2,500. Down payment $500. Another $1,000 when gold nuggets are actually produced from restored split atoms. And a final payment of $1,000 when the buyer sees his very own machine producing $1,500 per week.

Mr. Bean recounts his own feeling of frustration while working on the baffling problem of making $1,500 in gold nuggets grow where only 30 cents was found by the fire assay. But in the hour of his success he generously offers to sell his machines to others instead of using them to enrich himself at the rate of $1,500 per week per machine. Such is the self-sacrifice of the true scientist.

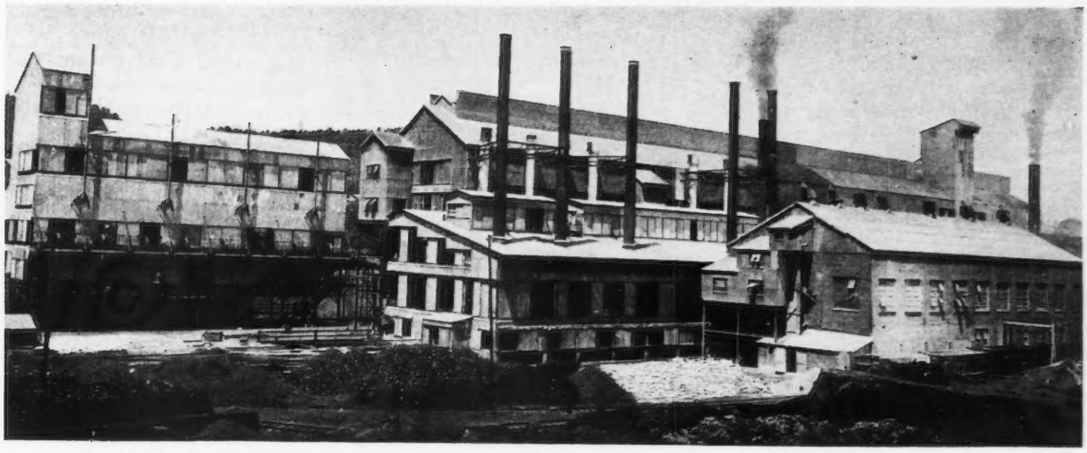
We can scarcely believe that anyone would be gullible enough to invest in one of Mr. Bean's machines. In fact, we find it hard to believe that even Mr. Bean himself hopes to do more than arouse an amused interest in his fantastic tale. And yet, there's the story on the letterhead of the O. U. Bean Processes Laboratory, Los Angeles, and some sucker might bite. Maybe Mr. Barnum was right. But somehow Mr. Bean's "catylectic" process leaves us in a state of catalepsy.

With Reference to Silver

IN QUEST of a fair omen for silver, enthusiasts might remind us that the alchemists selected as its symbol the crescent moon—a moon that is just beginning to show its glory and that surely as the days roll around will grow to full perfection. Their opponents might retort that the same long-bearded wielders of crucible and alembic also called the metal Luna and might pun caustically with the name at the enthusiasts' expense. But we shall pursue the middle course—the golden mean of Horace—and recall to mind that the bewhiskered seekers of the philosopher's stone also knew the white metal as Diana—fair goddess of the hunt—and how fittingly! A metal hunted eagerly for ages down to the present day and now the center of a perplexing argument in which the participants have whirled like dervishes or planets or a cat chasing its tail, all hunting the last word, the devastating answer, the solution of the problem, and still dizzy from it.

Having thus disposed of the principal economic aspects of this important silver question and leaving the baffling answer in the lap of the self-same political gods to whom we consigned it some months ago, we pause—to breathe and to announce that silver production is on the increase in the United States; that domestic producers appear quite content to have the price around 77 cents or thereabouts, while they wait trustingly on a hitherto benign Administration; that Mexico eyes Roosevelt hopefully; and that London speculators recently tried a whirl all their own, failed to get far, and then subsided.

And, lest money specialists forget, silver has important uses in industries of varied kind: table ware, photography, and electroplating and other chemical uses; in jewelry, engineering applications, and dental supplies, the last of which, when stowed in their intended place, are akin to both jewelry and materials of construction and maintenance. Likewise, the metal's uses in solders and alloys and for bactericidal purposes are increasingly of interest. As a stimulus to greater industrial application, the bulletin entitled "Silver: Its Properties and Industrial Uses," just issued by the National Bureau of Standards, should be effective. It is the outcome of a survey of the engineering uses of the metal which has been backed by eight of the leading silver-producing companies of the United States. Known also as Circular C412, it comprises 72 pages, selling at 10 cents, without a doubt one of the biggest 10-cent bargains to be had just now in Washington.



VERTICAL RETORT PLANT of New Jersey Zinc Company, at Palmerton, Pa. At the left is the gas house. At the right of this in the rear is the furnace building, and in front of the latter at the right is the mix house. The plant contains 28 retorts. The building in the front center is a refinery

An Advance in Zinc Smelting

The Vertical Retort Process Is Developed by the New Jersey Company

•

Successful, It Has Overcome Many of the Shortcomings Of the Horizontal Muffle

•

Four Plants Now Use It And a Fifth Is Building . . . That at Palmerton Is Here Described

•

E. H. Bunce

General Manager, Technical Department
New Jersey Zinc Company
Palmerton, Pa.

EARLY in 1925 the New Jersey Zinc Company undertook the development of a mechanized process for the smelting of zinc which would give (a) improved elimination and recovery of zinc; (b) a product of greater purity than had theretofore been obtainable from ordinary ores by pyrometallurgical methods; (c) lower costs of production; (d) reduction of labor and improved working conditions; and (e) a method of smelting zinc ores that could not be smelted by processes previously employed.

To obtain these results it was necessary to depart radically from the accepted long-time method of smelting zinc ores. Instead of horizontal muffles of relatively small capacity, vertical retorts many times larger had to be developed; the arduous manual labor of the old "batch" method replaced by the mechanized operation of a continuous process; the problems incident to the efficient condensation of a continuous stream of zinc vapor in large volume solved; and means found for eliminating from the metal product the metals other than zinc that are commonly found in zinc ores, so that metal of high purity might be produced.

The successful development of this process affords an interesting chapter in the history of zinc metallurgy.

General Description of Process—Zinc ore and a carbonaceous material, some portion of which must have coking properties, are intimately mixed and densified. This densified mix is briquetted and the briquets are coked in a vertical coking furnace, the hot waste gases from the reduction furnace being utilized to supply the necessary heat. Then the hot coked briquets are charged into the top of a vertical reduction retort, which is kept full, the residue being continuously discharged from the bottom. The retort gases, consisting principally of zinc vapor and carbon monoxide, are conducted upwards through the retort, then through the vertical extension of the retort, where entrained dust and some lead are removed, and finally into a condenser. At appropriate intervals the condensed metal is tapped off. The gases leaving the condenser are passed through a scubber, where the remnants of zinc they contain are recovered. The cleansed gases are conducted to the firing chamber, where they are utilized to enrich the heating gases.

History of Development—The development of this process led into many new fields that had to be thoroughly investigated to find solutions of the diverse problems that arose during the progress of the work. The study of mix preparation, the coking of agglomerates, rate of reduction, retort construction and firing, and condensation—all had to be carried on simultaneously, and new mechanical problems presented themselves with each change in size of the experimental unit.

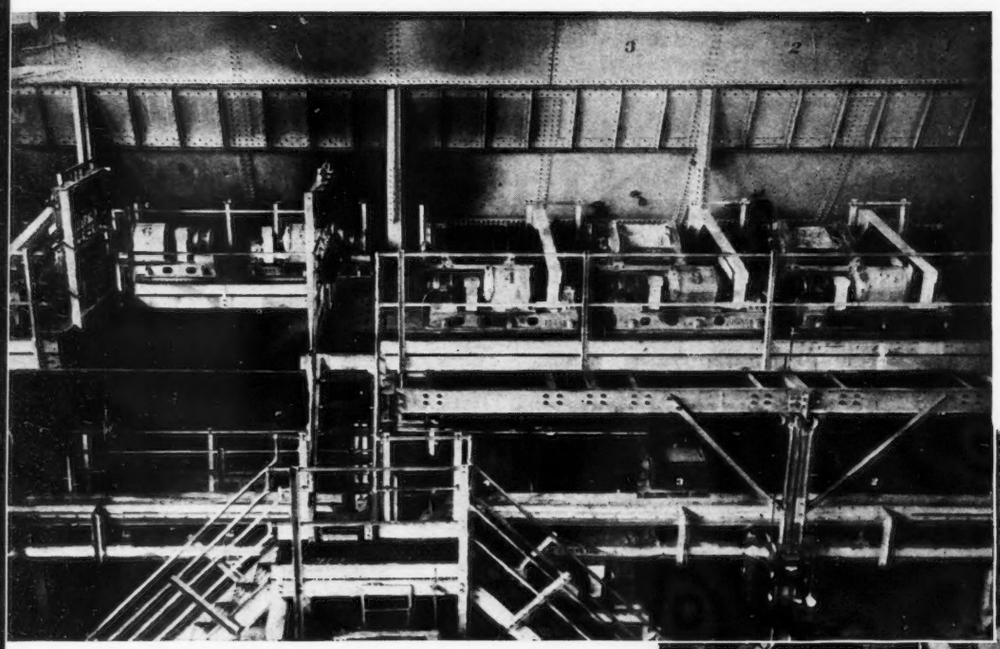
That to obtain the desired results it would be necessary to utilize vertical

retorts of relatively large capacity was early recognized. The size of the usual horizontal zinc muffle is limited by the poor heat conductivity of the charge and the structural weakness of the material of which the muffle is made. To overcome these limitations so as to permit the use of a much larger retort it was essential to improve the heat transfer of the charge and to develop a different type of retort.

A detailed laboratory study indicated that the most feasible way of improving the heat transfer of the charge would be to form it into dense agglomerates such as briquets. The individual agglomerates were found to have good heat conductivity and the voids in the charge between the individual agglomerates tend to facilitate the passage of gases through the charge and also to permit the transfer of heat by radiation and convection.

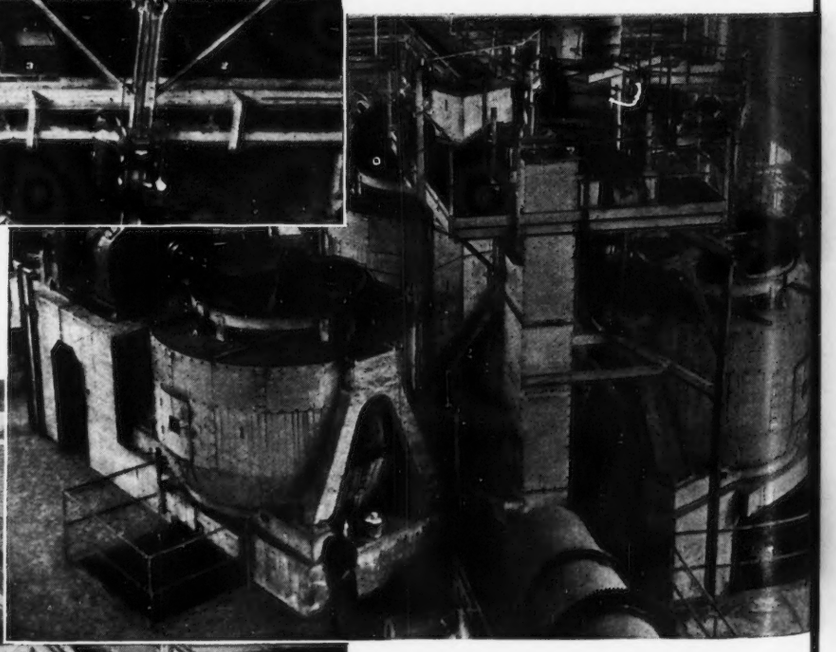
With the successful development of an agglomerated charge a vertical retort was found to be practicable. The use of an agglomerated charge in a vertical retort offered the following advantages:

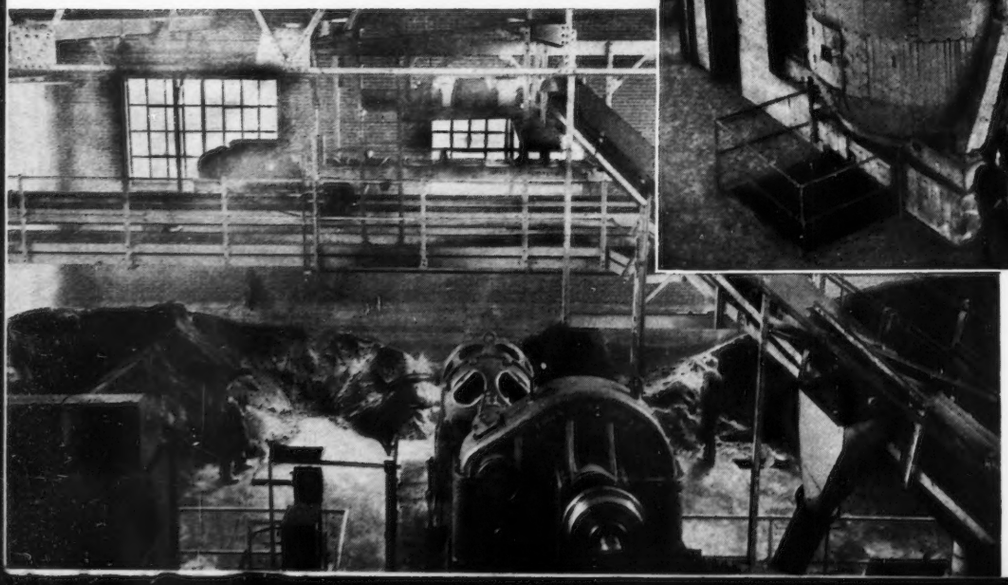
1. An agglomerated charge moves through a vertical retort by gravity without mechanical aid.
2. Use of an agglomerated charge promotes rapid heat transfer from the hot walls of the retort to the center of the charge by radiation, conduction, and convection.
3. The retort gases can be conducted upwards through the retort and thence through the condensation system, either by introduction of displacement gas at the bottom of the retort or by control of the stack draft in the retort.
4. Use of an agglomerated charge avoids the tendency of a loose charge to slag and to bridge or hang.
5. A vertical retort permits easy charging and continuous discharging, causing the reducing reaction to take place so uniformly that a continuous stream of zinc vapor of constant volume and composition is delivered from the retort, thereby making it practicable to cleanse the vapor and secure its efficient condensation to molten metal; also to recover the condenser gases.
6. A vertical retort may be made structurally strong and of large size.
7. A vertical retort permits much of the weight of the charge column to be carried by the column itself, avoiding any severe pressure on the walls of the retort, although maintaining contact therewith.



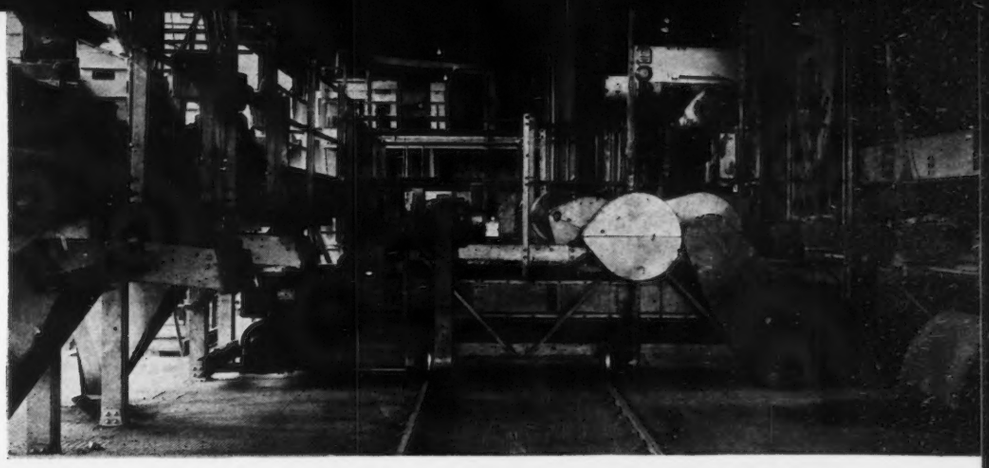
STEEL FEED BINS and automatic scale for proportioning the mix. The materials are then passed to a rotary mixer and then treated in Chilean mills. After being thus prepared, the mix is stocked for use later

BATTERY OF CHILEAN MILLS (below) in the mix house. The rotary mixer is seen in the foreground. It passes the mixed ore and coal to the elevator shown, which in turn delivers the mixture to the battery. Here the binder is added



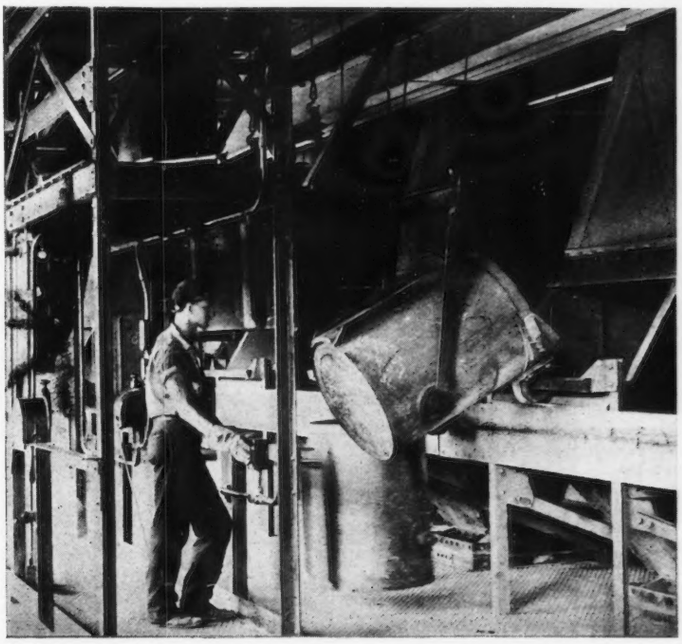


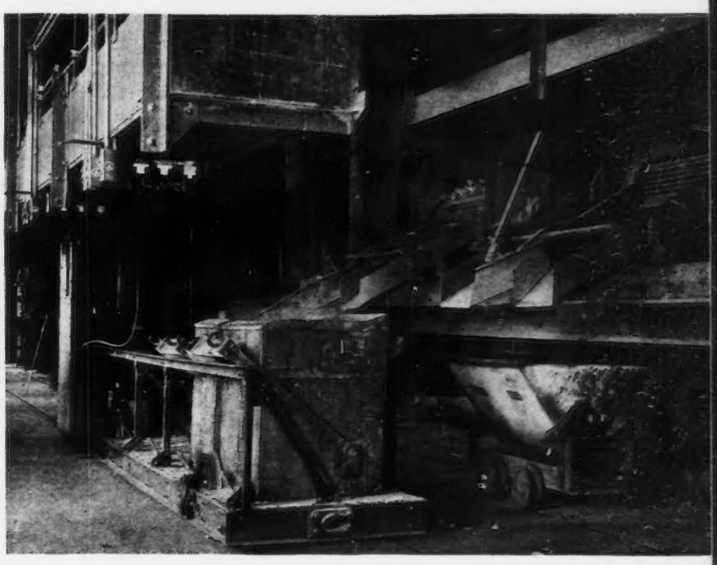
CONVEYORS deliver the mixed charge to storage space provided. It is then shoveled on to one of five belt conveyors under the floor, which takes it to a cross-collecting belt that runs to the furnace building



BRIQUET PRESS, on platform at left, and accumulator car feeding the coking furnace. There are two presses in parallel and two cars. The latter provide temporary storage, the cokers being charged intermittently

AN ELECTRIC HOISTING LARRY lifts the hot coked briquets to the charging floor in steel buckets, which it then carries to weighing scales and then to the charge hoppers over the retorts





COKED BRIQUETS are discharged from each vertical coking unit by a horizontal drum. They drop onto a traveling grizzly, which screens out the fines and passes the briquets to containers handled by the larry. The fines fall into the V-bottom car

A retort 3 ft. high and 8 in. in diameter was used in the first experiments in 1925, which were followed by some months of work on a higher retort of the same diameter. Thereafter the experimental work proceeded more rapidly, and furnaces of several sizes were in operation at one time, ranging all the way from 2 ft. to 25 ft. in height, and from 4 in. to 30 in. in diameter. At one stage of the development eight furnaces were in operation, ranging in capacity from a few pounds to a ton of metal per day. The small furnaces were used to develop new ideas, which were tried out on a large semi-commercial unit.

The retort in the semi-commercial unit was 25 ft. high. This furnace was in almost continuous operation from April, 1926, to May, 1929, the only shutdowns being for the purpose of changing to new designs of retorts and condensers and methods of firing. One retort in this furnace had a total operating life of 552 days and was intact when shut down. In addition to the work on retorts, 38 condensers were built and tried.

Throughout this period, investigations were carried on in the laboratory to determine various factors involved in reduction, coking, and condensation. A test was developed to determine the theoretical rates of reducibility of different ores, together with the reducing properties of various carbonaceous materials. Theoretical factors in the condensation of zinc vapor were studied, and a method was developed to produce satisfactory coke in the charge briquets.

Work was continued at the semi-commercial plant until May, 1929, and in all 1,300,000 lb. of zinc was produced. In November, 1927, engineering work began on the design of a sixteen-retort plant to be located at Palmerton, Pa. This plant was put in operation in May, 1929, and an extension of twelve more retorts was placed in operation in the first half of 1936. In July, 1929, an eight-retort plant began operation at Depue, Ill., followed, in August, 1930, by a sixteen-retort plant at Spelter, W. Va. Late in 1934, a sixteen-retort plant was put into service at Avonmouth, England. An initial unit comprising eight retorts is under construction in 1936 at Oker, Harz, Germany.

Detailed Description of Process[1] *and Its Development*—A detailed account of the process and its development may be in order before the actual operation of a commercial plant is described. For this purpose the process may be divided into seven main steps:

1. Preparation of the mix and its agglomeration.
2. Coking of the agglomerates.
3. Retort construction.
4. Reduction of the charge.
5. Functions of the upper extension of the retort.
6. Condensation—Recovery of condenser gas.
7. Product.

[1]The New Jersey Zinc Company's vertical retort zinc smelting process is covered by the following United States patents:

1,378,411	1,835,460	1,929,408
1,678,607	1,838,296	1,983,025
1,680,726	1,863,711	1,998,440
1,712,132	1,873,861	2,009,547
1,749,126	1,877,123	2,013,980
1,749,127	1,896,221	2,015,336
1,810,070	1,918,245	2,021,284
1,811,910	1,921,820	2,036,566

and corresponding patents in many foreign countries.

1. *Preparation of the Mix and Its Agglomeration*—The preparation and agglomeration of the charge involved several distinct problems which will be discussed in logical order rather than the chronological order in which they were studied.

The formulation of a proper mix is a problem which must be solved in each individual case according to the ores and coals available. Coking characteristics of bituminous coals vary widely and those economically available must be tested with the ores to be used. The carbonaceous material may be all bituminous coal or partly bituminous coal and partly anthracite fines or coke breeze. When coke fines from the coking units (cokers) are recirculated in the mix house, suitable adjustments are made in the percentage of ore and coal in the mix. The proportion of ore to carbonaceous material may be varied to suit individual requirements. It usually ranges between 60 and 70 parts of ore and 40 and 30 parts of carbonaceous material by weight. The mix is usually so adjusted that the zinc content of the final coked briquets will average between 38 and 48 per cent. Obviously, it is desirable to keep the zinc tenor in the coked briquets as high as good coke and residue strength will permit.

Both the size and the shape of the agglomerate or briquet are important, since the rate of heat transfer through the charge as a whole is affected by the size, shape, and number of voids between the briquets. The heat penetration into the briquet itself is also a function of the dimensions of the briquet, and, finally, the resistance of the charge to the upward flow of the carbon monoxide-zinc vapor mixture also depends on the voids. Systematic study of these factors through experiments with briquets of many shapes and sizes led to the adoption of a pillow-shaped briquet 4 in. long by $2\frac{3}{8}$ in. by $2\frac{1}{2}$ in. It weighs about 1.2 lb. wet, 1.1 lb. dry, and 0.86 lb. coked.

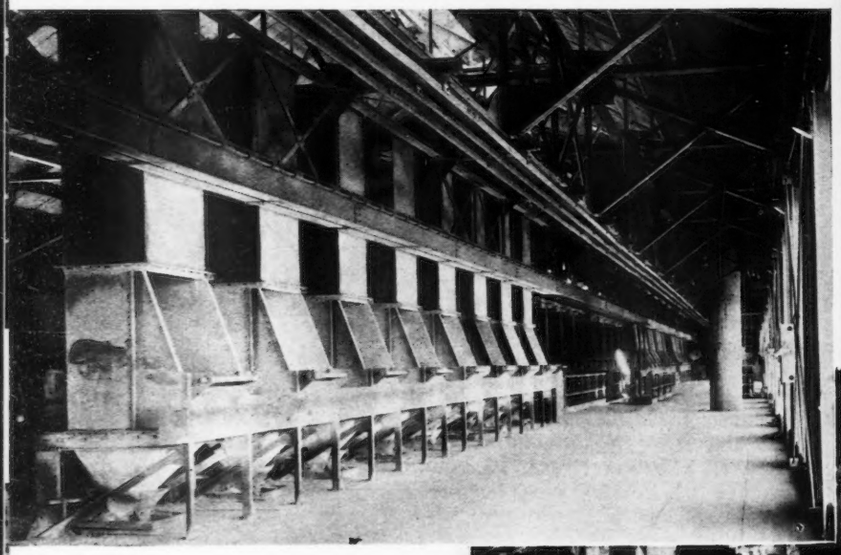
The strength of the briquet before coking, during coking, after coking, and during and after reduction is important, because presence of fines resulting from friable briquets fills up the voids which are essential to both the coking and reduction operations. The strength depends on proper sizing of the ore and coal, intimate mixing with a suitable binder or conditioning agent, and adequate densification of the mixed charge prior to briquetting. Also, the size of briquet adopted makes the densification requirements especially severe, and the unit strength required to resist breakage is, of course, higher than for a smaller size.

Requirements as to sizing vary with different ores and coals and ratios of bituminous to anthracite coal. In general, however, all components of the charge are of a graded size from through 20 to through 200 mesh.

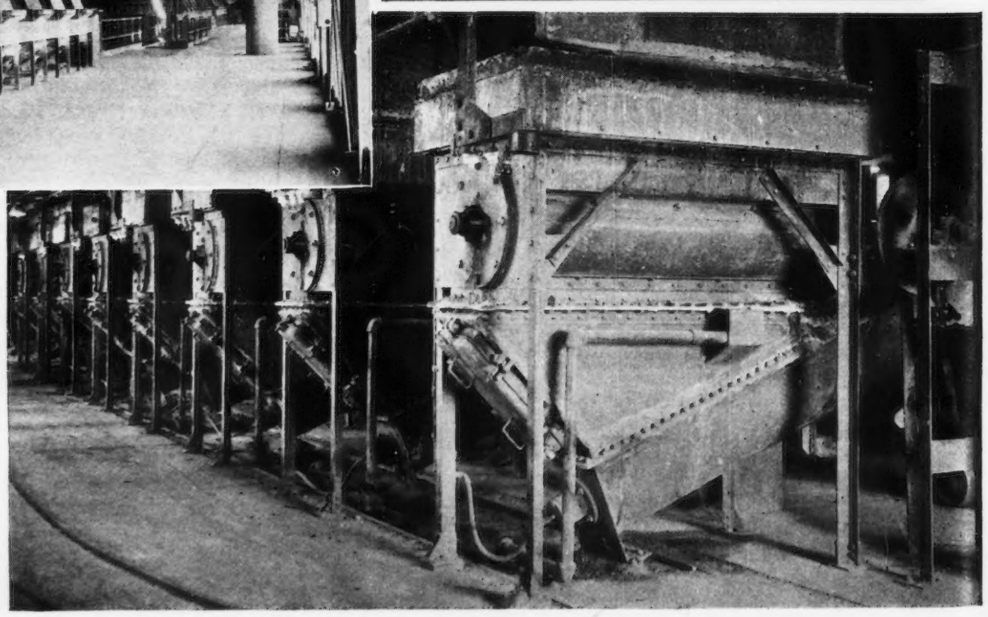
Mixing and densifying may be accomplished with paddle mixers, chasers (Chilean mills), and densifying rolls. One or more of these types of equipment may be necessary in handling various mixes. Sulphite liquor, tar, pitch, or a similar conditioning agent in small amounts is frequently used to aid mixing and acts as a binder. The most satisfactory means for agglomerating the charge has been found to be a roll press.

2. *Coking of the Agglomerates*—One essential factor of the entire process herein described is that the individual agglomerates making up the charge in the vertical retort shall retain their shape throughout the entire reduction period, so that the porosity of the charge as a whole may be maintained.

EXTENSIONS, in rear view, of Nos. 17 to 24 vertical retorts at Palmerton. The zinc vapor and gases pass upward through these and thence into the condenser sump through an insulated baffle-equipped conduit



THE CHARGING FLOOR. On the left are the charge hoppers into which the briquet charge is dropped to be fed into the retorts. Charging may be done at intervals of from 15 minutes to 1½ hours



RESIDUE DISCHARGERS for Nos. 1 to 16 vertical retorts at the Palmerton plant. The residue is continually removed at the bottom of each retort, a worm conveyor in the upward sloping box propelling it to discharge

To accomplish this it is necessary that the agglomerates be bonded with a material that will not lose its strength as the reduction of zinc proceeds. One of the simplest means of effecting this is to form a coke structure by coking bituminous coal, or tar or pitch binders to hold the entire agglomerate together with a coke bond that will not be disintegrated or entirely consumed during the reduction operation. For the reason that in most locations the cost of tar or pitch in the quantity necessary to form good coke is prohibitive, development work was concentrated on the use of bituminous coal for the purpose.

In addition to the carbonaceous material used to form the bond, further reduction fuel, such as bituminous coal, anthracite coal, coke breeze, or suitable mixtures of these, may be used. At least 15 per cent of the mix, however, must be a good coking coal or its equivalent. This percentage may vary, depending upon the coking characteristics of a particular coal.

In the coking process as developed the briquets are heated directly by means of the exit waste gases from the reduction furnace. This direct application of heat insures an efficient utilization of fuel and a short coking time. The rate at which heat may safely be applied depends upon the nature of the bituminous coal or other coking agent used. In all cases the final coking temperature is between 750 and 900 deg. C., and the temperature of the gas leaving the coking unit varies from 300 to 700 deg. C., depending upon the rate at which coking proceeds. It may be economical in some cases to employ a waste-heat boiler to recover heat from the exhaust coking gases, to take advantage of the latent heat of the volatile matter of the bituminous coal, as well as of the sensible heat in the gases.

A great deal of effort was devoted to the development of the coking process. Attempts were made at first to coke indirectly—that is, by the use of an externally heated coking retort—but this was found to be slow and expensive. The difficulty of getting the heat from an outside heating chamber through the retort wall and into the core of the charge, without at any time subjecting parts of the charge to a reducing temperature (in excess of 900 deg. C.), rendered this method unsuitable. Coking time was excessive (four hours for complete coking), the firing costs were high, and the coking was non-uniform. Also, one serious difficulty was encountered in that a mixture of ore and bituminous coal tends to go through a softening point as the lighter oils and tars are driven off. This softening was aggravated by the steam from the wet briquets, since briquets were used directly as they came from the press. Though it was found that drying was beneficial, the difficulty of softening and deforming in the early stages of indirect coking could not be readily overcome and was a further reason for condemning this method.

The next attempt was to coke the charge by direct contact with hot reducing gas. It was found that, by subjecting the wet briquet suddenly to the final temperature of coking—namely, 900 deg. C.—a shell of coke was immediately formed on the surface of the briquet. This shell gave sufficient strength to the briquet, so that it did not deform or crack during the remainder of the process in which the briquet was completely coked. Due to the fact that the hot gas was in direct contact with the coke, the time of coking was materially reduced.

The next step was to use waste gas rather than reducing gas, and it was found that the gas from the furnace chambers heating the reduction retorts, averaging about 15 to 18 per cent CO_2, was entirely satisfactory, and that it was possible to get satisfactory coked briquets with as high as 5 per cent oxygen present in the gas. In order to get rapid coking, it was necessary to pass a large volume of hot gas through the mass of green briquets to be coked. It required about 30 cu.ft. at 0 deg. C. per pound of coke. To carry out this coking process, it was, therefore, necessary to have a relatively narrow mass of briquets to offer a minimum resistance to the passage of the hot gas. The expedient adopted was to use a vertical coking furnace with the gas traveling at right angles to the flow of the briquets, and the coker that was finally adopted for the work employs this method.

Both rate and method of coking are largely dependent upon the quality and quantity of bituminous coal available for forming the coke bond. Several modifications of the direct-coking process have been tried and worked successfully. It has been possible to coke briquets containing as little as 15 per cent bituminous coal and as much as 50 per cent bituminous coal. In some cases it has been found advantageous to dry the briquets before coking, but usually wet briquets may be coked directly as they come from the briquet press.

3. *Retort Construction*—Various designs of retorts and different kinds of refractories were tried before a satisfactory retort was developed. The first retort was 8 in. in diameter and 3 ft. high. The next was built by joining two silicon carbide tubes, 8 in. in diameter, 5 ft. high, 1 in. wall thickness, with a bell and spigot joint. These gave a life of 245 days. The next step was to try bell and spigot silicon carbide shapes of oval 12x18 in. cross-section, 18 in. high with 1½ in. walls. These were placed one on top of the other with silicon carbide cement between. This retort had only a short life, as the pieces developed cracks that widened rapidly. It was thought that possibly this cracking was due to the strains caused by the enlarged section of the bell; therefore, plain cylindrical pieces, of 15 in. inside diameter and 2 in. thick, were next tried. These had a somewhat longer life, but they still failed by cracking. However, this retort brought out the important point that plain joints of silicon carbide cement could be made satisfactorily zinc-vapor tight.

The next logical step was to make the retort of smaller pieces, on the theory that most of the cracking was due to strains set up in the retort during the firing and charging period, and that, if it were made of smaller pieces joined together with suitable cement that did not become entirely rigid until the full temperature of operation was reached, there would be enough play between the individual pieces to allow relatively free movement during the early firing stages, so that, when the full temperature was reached, there would be no resulting destructive strains. With this in mind, a 16 in. circular retort was made using silicon carbide circle bricks, 4½ in. wide and 2½ in. thick, with eight bricks to the circle. This proved to be a satisfactory retort and had 18½ months of operation with excellent recoveries obtained and was good at the time it was shut down.

The next step was to try retorts of larger diameter, and 30-in. and 20-in. retorts were subjected to test. The 30-in. retort proved to be too large to permit satisfactory heat penetration to the center of the charge, and though the 16-in. and the 20-in. circular retorts gave good recoveries, they were limited in capacity. Therefore, since the aim was to get a retort that would produce at least 6,000 lb. of zinc per day, further development was necessary.

Experimental work indicated that to obtain good zinc elimination it was essential so to design the retort that the depth of the heat penetration into the charge would not exceed 10 in. As the circular type of retort had the disadvantage of small capacity, the next logical step was to try a racetrack section 18x36 in., built up of 9-in. bricks. Also a rectangular section, 18x36 in., built of 9-in. bricks was tried. The racetrack proved to have no advantages over the rectangular section and was more difficult to construct. With the rectangular retort the capacity was increased and the retort had a fairly satisfactory life, but after six months of service it developed cracks at the cor-

ners, causing it to fail. There were many advantages in the rectangular retort, and, as the stresses seemed to be localized at the four corners, the next step was to provide in the construction for the release of the strains. To accomplish this the retort was built with four separate walls.

This retort, commonly called the "slip-joint" retort, embodies two rather heavy end walls with vertical slots into which the long side walls of the retort are fitted. Glands are provided in the slots and are filled with a granular material as a vapor seal. The entire retort is built up of standard shapes with the exception of a few special shapes in the end walls. This retort is so built that there can be no binding and the four walls are entirely independent of each other, so that within limits they are free to move longitudinally or vertically, without any effect on each other.

As mentioned in the foregoing, it was found that for good zinc elimination depth of heat penetration into the charge should not have to exceed 10 in. and even this is excessive for maximum capacity and elimination. With this in mind, in subsequent designs the retort was narrowed to 12 in. (6-in. penetration) and the long side walls were increased from 3 to 6 ft., maintaining the same height of 25 ft. This has proved to be a highly satisfactory form of retort, the oldest of the retorts of this type now having been in continuous operation for more than five years. With the slip-joint construction there has been no indication that 6 ft. is the maximum permissible length of the heated long side walls. Retorts with walls 7 ft. long have been successfully operated.

Work on refractory materials clearly indicated the advantage of silicon carbide over any other material for building retorts of this size for zinc reduction. Silicon carbide has a high heat conductivity and thereby permits the use of thick walls. It has a low coefficient of expansion, and, therefore, large-sized walls can be built without danger of cracking due to expansion and contraction. Individual bricks can be made true to form, and when bonded with silicon carbide cement form a vapor-tight retort. Silicon carbide is less sensitive to heat shocks than most refractories and under the temperatures and conditions of operation there is little attack either by the firing gas on the outside of the retort or by the reduction gas on the inside of the retort.

Retorts have been constructed of alloys and some have appeared promising. Their use is restricted by the fact that firing temperatures cannot exceed 1,000 or 1,100 deg. C. and that the slow progressive deformation of the metal that occurs at high temperatures introduces structural complications. Refractory retorts may be fired at substantially higher temperatures, and the structural problems that they present have been well worked out.

In its finally developed form, the retort is a simple shaft extending vertically through a furnace heating chamber. The design of this chamber has been developed to permit the fairly close control of temperature and atmosphere which is required by the close tie-up between the coking operation and the reduction operation. A down-draft furnace chamber is used, which is maintained under suction by fans on the exit side of the coking furnace. Since the gases from the retort furnace chamber are drawn through the coking furnace and so must not be strongly oxidizing, a bypass is provided from the main gas-supply line to the flue connecting the reduction furnace with the coking furnace. By admitting producer gas through this bypass, any excess oxygen in the exhaust gas feeding the coking furnace may be consumed. This arrangement makes possible the flexible and independent control of the two units.

The relation of the physical condition or state of agglomeration of the charge to the reduction operation has been pointed out. Obviously, the size of the reduction retort will be limited by structural considerations and in one direction at least by the rate of heat penetration through the retort walls and into the charge.

4. *Reduction of the Charge*—For reasons discussed in the following section, the retort is extended upward above the furnace setting for some distance and is provided at the top with a charging hopper which provides an effective seal. The offtake through which the carbon monoxide-zinc vapor mixture is conducted to the condenser is at a level well below the top of the charge column. As will be explained a little later, this arrangement prevents any interference with proper conditions for condensation during the charging periods.

The vertical retort may be charged at any desired interval, but it is usually preferable to charge at no greater interval than one and one-half hours. The hot coked briquets delivered from the coking furnace are immediately charged into the vertical retort. Charging of the briquets while hot serves to facilitate the reduction and also insures minimum CO_2 content in the gases fed to the condenser. This is of utmost importance for obtaining high condensation efficiency.

Under normal conditions there is an elimination of about 96 per cent of the zinc in the charge, and an over-all recovery of 92 per cent or better. Any suitable extractor may be used at the bottom of the retort, and as the residue remains in the form of agglomerates and is always dry—that is, it is solid throughout without any evidence of fusion even on the surface—discharging of the residue is very simple. Furthermore, due to the fact that the individual briquets making up the charge retain their original shape, there is no tendency for the charge to hang, and there is no slagging in the retort even in those retorts that have been operated for several years.

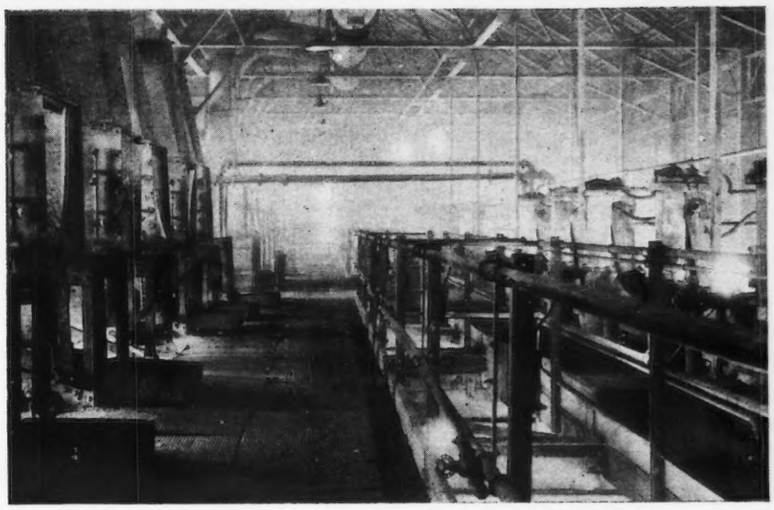
A type of bottom construction that has proved to be quite satisfactory embodies a metal extension of the retort. The extension is attached to the bottom casting, which supports the retort and terminates in a water seal. Near the bottom of the retort extension there is a continuously revolving cylindrical spider which is set to discharge the residue from the retort at an appropriate rate into a screw conveyor closed with a water seal. The residue is carried upward by the screw conveyor and discharged onto a belt conveyor or directly into a dump car.

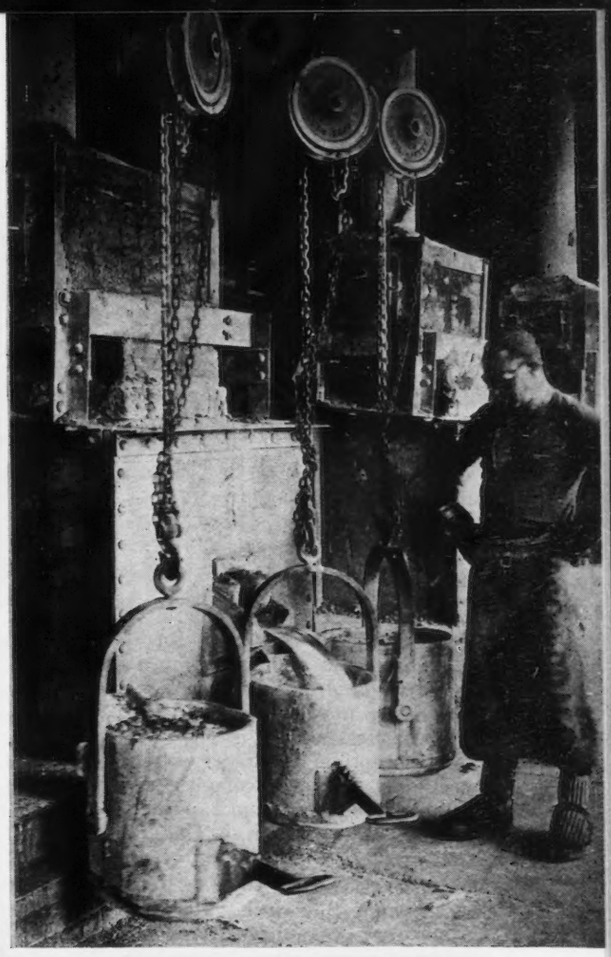
An appropriate amount of air, waste gas, or reducing gas is introduced into the base of the retort extension under sufficient pressure to provide a uniform and positive flow of gas upwardly through the retort. This expedient provides an effective control of the movement of the vapor and gases through the system and prevents the diffusion of zinc vapor downwards from the retort into the cooler bottom extension.

5. *Functions of the Upper Extension of the Retort*—The length of the extension of the retort upward from the arch of the furnace is an important factor in the operation of the system. Hot gases flowing upward from the heated zone of the retort serve to preheat the descending briquetted charge, thereby effecting a heat interchange, so that the charge as it enters the heated retort is at the temperature of reduction and the gases as they enter the condenser are partially cooled. The extension also serves as a charging chamber, which is kept sealed by the descending charge, so that the intermittent introduction of fresh briquets at the top of the extension does not materially affect the conditions in the heated section of the retort.

Furthermore, the retort extension constitutes a reaction chamber between the retort proper and the condenser. The presence of the reducing agent contained in the fresh charge descending through the extension tends to remove the oxidizing gases, such as CO_2, which otherwise would be formed by reversal of the gas-producer reaction in the stream of vapor and gases as it traverses the descending temperature gradient encountered upon leaving the heated retort. Any chemical zinc dust formed is deposited for the most part on the descending charge and is carried downwards into the reducing zone.

6. *Condensation, Recovery of Condenser Gas*—The fact that a continuous stream of zinc vapor of constant





CONDENSATION of zinc vapor (upper right) takes place at a temperature ranging from 825 to 875 deg. C. at the conduit entrance and from 525 to 575 deg. C. at the condenser outlet. The metal is drawn from the sump at intervals, as here illustrated

CASTING THE ZINC (upper left) on the condenser floor after it has been drawn in ladles from the condenser sumps at the right. The molten metal is poured into molds of conventional size. These are seen at the left

A REAR VIEW (lower left) of the charge hoppers (on the left), at the Palmerton plant, and the condenser outlets showing the scrubbers. The latter are on the right

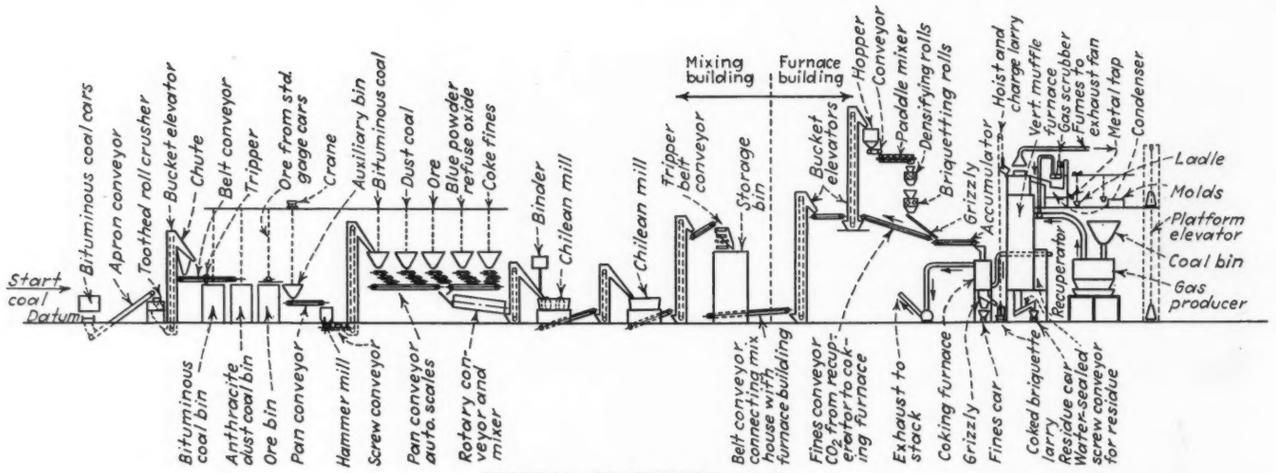
A FURNACE CHAMBER (right) as seen from above. The retort is shown under construction. Note the air ports in the sides. The latter serve to effect the combustion of the fuel gas as it passes downward

composition and volume is delivered from the vertical retort simplifies the operation of the condenser. The condensing system consists of an inclined channel from the retort and a collecting sump. Baffles in the channel permit rapid removal of heat from the zinc vapor and condensation of the greater part of the zinc. The cooled and more dilute vapor enters the insulated sump, which holds a temperature well above the melting point of zinc, thereby preventing blue powder formation. The entire system is relatively small and has a high condensation efficiency.

Definite pressure and temperature are maintained in the condenser, depending upon the amount of zinc vapor to be condensed, and by controlling these factors it is possible in the same condenser to vary the amount of condensed zinc over as wide a range as from one ton to four tons per day with equally good condensation efficiency. The condenser sump holds about a ton of metal and it is not necessary to tap the condenser until this ton of metal has been accumulated.

The retort extension is traversed by the gases passing from the retort to the condenser and is kept full of hot coked briquets. Therefore, the CO_2 content of the gases entering the condenser is low. Exhaust gas from the condenser averages about 0.6 per cent CO_2 and 55 to 85 per cent CO, depending upon the amount of dilution due to displacement gas introduced at the bottom of the retort.

Another important function is performed at the exit from the condenser. The pressure of gases in the retort is governed by the balance between displacement gas and the back pressure in the system. As previously mentioned, the back pressure which is caused by the interstitial resistance of the charge is kept at a minimum by suitable briquet design. Control of pressure throughout the system is, therefore,



GENERAL FLOWSHEET of the vertical retort smelting plant of the New Jersey Zinc Company at Palmerton, Pa.

mainly localized at the condenser exit.

In any zinc condenser there is a certain amount of building up of solid material on the cooling surfaces, and one of the problems involved in reaching a successful design was to provide by appropriate location of cleanout ports for easy and complete cleaning of the condenser without seriously affecting its operation. The production of zinc dust averages 5 per cent, based on the zinc burden.

The high B.t.u. exit gases from the condenser pass through a scrubber which removes from them the last traces of zinc dust—2 or 3 per cent. Then the cleansed gases are sent through an injector and connecting lines leading to the firing chamber to be burned, thereby lessening the fuel requirements for firing the retort.

7. Product—The primary function of the vertical retort process is the production of zinc vapor. Though the commercial plants so far placed in operation are devoted to the production of slab zinc, zinc dust has been produced by conducting the zinc vapor into an appropriate form of zinc-dust canister, and zinc oxide of commercial grades has been produced by burning the zinc vapor in an appropriate apparatus and collecting the resulting fume. Practical experience has shown that the vertical-retort process is as effective in the production of zinc oxide and zinc dust as in the production of slab zinc.

Treatment of the metallic zinc product of the vertical retort process by rectification, as described in the company's United States patents Nos. 1,980,480 and 1,994,345 to 1,994,358, inclusive, gives a product of 99.99+ per cent pure zinc.

The Commercial Plant at Palmerton—This plant is divided into two main parts, the mix house and the furnace building. The mix-house operation includes unloading and stocking of coal, ore, and binder, and the preparation of the mix, including the stocking of the mix after treatment in the Chilean mills. The furnace building furnishes shelter for the briquetting and coking equipment and for the reduction retorts, with their settings.

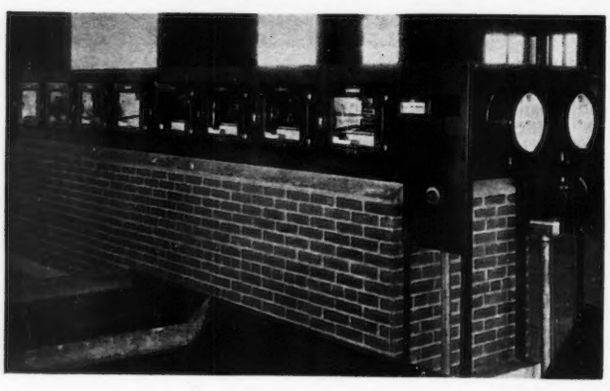
Mix-House Operation—Palmerton is located near the Pennsylvania anthracite field, and for this reason the use of bituminous coal is kept at the minimum necessary to obtain good coke strength, and anthracite is added to increase the amount of the carbonaceous material in the mix. Practically all of the anthracite passes 14 mesh and requires no further preparation. Ore up to 14 mesh may be used with no further crushing, but any material above this size requires crushing. The bituminous coal is crushed in a hammer mill to minus 6 mesh.

Anthracite dust, crushed bituminous coal, and ore are stocked in concrete bins at one end of the mix house. An overhead crane carries the ore and coal to parabolic-shaped steel bins having an ore capacity of about 20 tons each. These bins discharge onto apron conveyors which feed onto double conveyor automatic scales.

After the material is weighed, the scales discharge onto a collecting belt conveyor, delivering into a continuous rotary mixer, 4 ft. in diameter and 25 ft. long. Here the ore and coal are given a preliminary mix and dropped into the boot of an elevator, which lifts the mix into a pan mixer or chaser (Chilean mill), where the binder is added. Three of these pan mixers are provided, laid out with conveyors and elevators in such a way that any one, any two, or the three may be used to prepare the mix. Material from the pan mixer is distributed in the storage space for mixed charge by a series of conveying devices.

Then the mix is shoveled onto any

INSTRUMENT CONTROL is required for the most efficient operation of this plant, which is mechanized and equipped with units of large capacity. Here is a bank of instruments used for recording furnace chamber temperatures



THESE INSTRUMENTS control the coking operation. A pyrometer records both inlet and outlet temperatures on each unit, and a pressure gage records the pressure drop and controls the fan speed to maintain the required gas volume

one of five belt conveyors under the floor, which conveys it to a cross collecting conveyor carrying the mix underground to the furnace building. Here it is raised to the top floor by one of two elevators operating in parallel.

The mix house does not run on a 24-hour schedule, and, therefore, some storage of material between the mix house and the furnace building is necessary. Operation of the plant, from the briquetting to final reduction, is a continuous, closed circuit, with no opportunity for storing material ahead of the process, and, consequently, the accumulation of the mixed material at the storage house is the only protection against interruption. The plant is so laid out that failure of individual equipment will not necessitate a shutdown, and duplicate equipment is provided wherever it seems necessary for ample protection.

Furnace Building Operation—The mix drops from the chutes of the elevators onto a horizontal belt conveyor, which distributes it into one of two 7-ton bins. Each bin has a small apron feed conveyor, which discharges the feed from the bin to one of two paddle mixers, 10 ft. long, where additional water is incorporated in the mix. The wetted mix feeds from each paddle mixer into one of two densifying rolls. This is duplicate equipment, and it is usually necessary to run only one set, the other being held as a spare unit.

Briquetting—The densified mix from the rolls feeds directly into a briquet press. There are two briquet presses in parallel. The discharge from the press slides over a grizzly onto one of two belt-conveyor accumulator cars. Briquetting fines pass through the grizzly and a chute onto a belt conveyor, which returns the fines to one of the two mix elevators. The accumulator cars merely provide a temporary storage of materials, inasmuch as the cokers are charged intermittently.

Coking—The green, wet briquets are fed from one of the accumulator cars into one of the four vertical coking units. In passing down through the coking space the briquets are subjected to a continuous stream of hot exhaust gases coming from the furnace recuperators. This gas enters the coking chamber at about 850 deg. C. and passing horizontally through the column of briquets leaves at about 500 deg. C. The discharge of the coking furnace is kept fairly gas-tight by means of a dry seal. Coked briquets are discharged by means of a horizontal rotary drum, whereupon a similar volume of fresh briquets is charged at the top. The coked briquets drop onto a traveling grizzly with a divided chute feeding two steel buckets. Fines pass through the grizzly and collect in a small hopper, from which they are discharged into small steel buggies. From here they are recirculated through the mix house.

Smelting—The steel buckets filled with hot coked briquets are lifted to the charging floor by means of an electric hoisting larry, and the same larry carries the buckets to weighing scales and then to the charge hoppers over the retorts.

The charge is dropped into the charge hoppers and fed into the retorts, and the residue is continually extracted at the bottom. This charging operation may be at any desired interval from 15 minutes to 1½ hours.

The zinc vapor and gases pass upward through an extension of the retort. Thence they flow into the condenser sump through a downwardly inclined conduit equipped with baffles. Here the zinc vapor is condensed at a temperature ranging from 825 to 875 deg. C. at the entrance of the conduit and from 525 to 575 deg. C. at the outlet of the condenser, which outlet is maintained slightly above the charge level. The natural draft so created maintains a continuous flow of gases through the condenser during the entire operation, including the charging period if for any reason the scrubber-ejector system is not in service. Metal collects in the sump of the condenser and is drawn at periodic intervals. The tapped molten metal is cast into molds of conventional size.

Gas System—The producer gas is supplied by a battery of producers fed with anthracite coal. The system of firing the vertical retorts is of the suction type, with delayed combustion to insure uniformity over the long length of heated retort. All of the gas enters at the top of the furnace chamber and a regulated supply of air is admitted at five levels.

Uniform combusion and consequently uniform temperature are maintained throughout the furnace chamber by admitting the air for combustion through a multiplicity of ports arranged in rows at different levels. Products of combustion pass from the bottom of the furnace chamber into the bottom of the recuperator. A parallel flow multi-pass recuperator with three passes is employed. The gas leaves the recuperator at about 950 deg. C. and the air is preheated to about 850 deg. C.

Two large brick-lined insulated flues of 5 ft. 3 in. diameter carry the products of combustion from the recuperators to the coking furnaces. The retorts are grouped eight to the battery, and each battery has its own flue-gas line collecting the products of combustion from individual furnace chambers. Each coking furnace is connected to the raw-gas line so that make-up gas may be added whenever it is necessary to reduce the oxygen content of the flue gas.

Gases entering the coking furnace must not be over 900 deg. C. or reduction will occur, with resultant loss of zinc. The gases are drawn through the coking furnaces by means of large fans. These fans also provide the suction for the furnace chambers for heating the vertical retorts. It is necessary to provide water-cooled settling chambers between the coking furnace and the fans, to settle out any solid particles that may have been drawn through the coking furnaces, and to cool down the gases so that the fan can safely handle them. The exhaust from the fans passes through large steel flues into the bottom of a steel stack, from which the discharge is directly into the atmosphere.

Instrument Control—This plant, mechanized and employing large-capacity units, operating continuously, requires accurate instrument control for most efficient operation. A six-point recording pyrometer is provided for each furnace chamber.

Additional temperature readings are taken from time to time on indicating and optical pyrometers. The indicating instrument is also used to take the temperatures of the gas entering and leaving the condenser. Pressure gages are provided to control condenser pressures.

A pyrometer records both inlet and outlet temperatures on each coking unit. A pressure gage records the pressure drop across each coking unit and controls the fan speed, to maintain the required gas volume through the cokers. To control the oxygen content in the coking gases, a recording CO_2 meter is provided.

Conclusion

In the successful development of the vertical retort, many of the limitations and disadvantages of the horizontal muffle have been overcome. Mechanization, coupled with the use of large units, has made it possible to dispense with the highly specialized and arduous furnace labor formerly necessary and to operate largely by pushbutton and instrument control. The direct labor, which includes mix preparation, coking, furnacing, and metal handling, and the indirect labor, comprising ore and fuel handling, residue disposal, gas producing, and foremen, average about one man per ton of daily metal production. By the same considerations the thermal efficiency of the operation has been greatly increased.

The lower costs consequent to these results, the amelioration of working conditions and the replacement of specialized labor by mechanical controls, the high direct metallurgical efficiency, and the practically pure product obtained, mark the extent of the advance that has been made in the pyrometallurgy of zinc.

Mexico Spurs Inactive Mine Owners

Cancels several old grants where properties are idle

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BASING its action on Article 18 of the Mining Law now in force, the Federal Government in Mexico has started a new policy whereby it is trying to overcome the inactivity of mine owners. Titles to mining property that had been granted under the provisions of laws prior to Aug. 1, 1926, as was understood by both the Federal Government and the mine owners, could not be subject to any cancellation proceedings unless the owners of the properties concerned failed to pay the regular mining surface tax or "pertenencia" tax. Titles issued from Aug. 1, 1926, on—that is, numbered from 67,396 up—were subject to the obligation on the part of grantees to undertake certain mine assessment work in the manner prescribed by the regulations.

But, as stated in the foregoing, the Mines Department, acting upon instructions of the Secretary of National Economy, has recently declared the forfeiture of several mining titles issued from the time of the old Spanish Ordinances (1783) to Aug. 1, 1926, on property that remained undeveloped and inactive up to the present, and based its action on Article 18 of the Mining Law now in operation, which reads in part: "Titles or concessions issued according to the Law of Mineral Industries dated May 3, 1926, and in force since Aug. 1, 1926, and according to the mining legislation heretofore enacted, shall not require the issuance of new concessions, but the said titles or concessions shall remain valid unless they become forfeited or lost according to the laws under which they were granted."

Now, the old Spanish Mining Ordinances of 1783 and the Mining Code of 1884 clearly provided that mining titles were granted under the express condition of doing mine development work; so, following the views of the Mines Department, the fact that those mining claims still remain idle makes them fall under the sanction of forfeiture considering the provisions of both the old legislation and the new 1917 Constitution, which likewise requires the mining assessment work under the same penalty.

Also, the Mines Department argues that, although the mining laws of 1892 and of 1909 formally repealed the obligation of grantees to do any mine-assessment work and provided as the only cause for the cancellation of former titles the failure to pay mining surface tax, nobody should forget that General Venustiano Carranza, during his revolutionary régime, issued several decrees in 1916 and 1917 ordering all the mines of the Republic to start operations, under the penalty of forfeiture should they disobey the orders, and that those revolutionary decrees were later expressly ratified by the 1917 Constitution in its Article 27, whereby it requires the assessment work as one condition for the acquisition of mining concessions.

Retaining wall of an old patio

Support has been given the views of the Secretary of National Economy in every respect by the Supreme Court, its salient statement being (Sulphur Mining & Railroad Company vs. Secretary of National Economy): "Besides, even if the law under consideration were a retroactive one—which is not the fact—still, its application should be obligatory, since the exploitation and treatment of mineral substances to which the Mining Law refers are of public utility, and consequently the complaining party should not be entitled to abandon for an unlimited and indefinite time against the public interest the mining claim which was patented under the express condition of working and developing it."

At present the result is that mine owners whose properties were patented prior to Aug. 1, 1926, and for one reason or other keep them idle, find themselves in this alternative: either they work them to avoid the cancellation of title which would be declared upon the report of any interested party, or they shall have to transform their old title into a new concession which from the time or date of issuance shall subject the owner to the obligation of doing the regular assessment work, but at any rate by following the second procedure the present danger of cancellation of the old title is averted.

The regular assessment work should be evidenced by mine owners in the form of mine labor salary investments according to the area of the mining claim as follows:

Metallics—Salary investment for each pertenencia-year: 25 pesos for each pertenencia-year up to an area of 20 pertenencias; for each succeeding pertenencia up to 50 pertenencias, 30 pesos per pertenencia-year; and for over 50 pertenencias, 45 pesos per pertenencia-year. (One pertenencia or hectare equals 2.47 acres.)

Non-Metallics—Salary investment for each pertenencia-year: for the first 20 pertenencias, 15 pesos per pertenencia-year; for the succeeding pertenencias up to 50, 25 pesos per pertenencia-year; and for over 50 pertenencias 35 pesos per pertenencia-year.

Coal and Graphite—Salary investment for each pertenencia-year: 10 pesos for each pertenencia-year up to an area of 20 pertenencias; for each succeeding pertenencia up to 500 pertenencias, 15 pesos per pertenencia-year; for over 500 pertenencias, 25 pesos per pertenencia-year.

Views of the small mining operators, to the effect that the Secretary of National Economy did act contrary to the law and against a bona fide situation in canceling the old titles, have been presented in a legal report to the Senate, which has appointed a committee to investigate the matter.

Peru's Gold-Mining Industry Grows

New Mills Number Six, With Two More Under Consideration

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Cia. Aurifera Buldibuyo, Ltd.
La Paccha, Peru

MINING DISTRICTS and the principal points and localities mentioned in the accompanying text are shown in their approximate positions on this sketch map of Peru

WITHIN the last two years there has been a development in the gold-mining industry of Peru that has gone so far that six mills have been or are being built and the construction of two more, at least, is at present considered. These mills range in capacity from a nominal 50 to 200 metric tons per day. Their operation is characterized by fairly good recoveries without exceptionally fine grinding; avoidance of separation of sulphides for separate grinding or prolonged treatment; remarkably short period of agitation; in the case of four of the mills, all built by Allis-Chalmers, treatment by two-stage thickening after grinding with agitators between the two thickening operations; use of Moore filters, with both rotary dry-vacuum pumps and rotary compressors for blowing off the filter cake and for agitation; with Merrill-Crowe simultaneous clarification and precipitation in the bag type of precipitate filter.

The remarkable fact about this development is that all the exploitation and financing have been with Peruvian capital, which heretofore, in the last few decades at least, has been rather timid, as far as the mining industry is concerned, except where the mine has been of exceptional richness, and that usually in silver or in copper, the greater risks having been left to foreign, especially American, capital.

Probably it all began some three years ago, when the Cotabambas mine, in southern Peru, after operating a small mill with thirty 750-lb. stamps, decided to go modern with a new mill of 150 metric tons' daily capacity, a feature of which is the use of individual stamps of 2,000 lb. each, the building of a new and ample hydro-electric plant, and the carrying in of much of the equipment by airplane, some 90 miles from Cuzco, already described in *Compressed Air* and *E. & M. J.*

To most of us old-timers here in Peru, and by that I mean residents of not more than ten or twelve years back, a trip to almost any mine outside of a very few, such as Cerro de Pasco, Casapalca, and Yauli, meant a long journey by mule back. Some part of it might be done by

railroad, some part by auto, but sooner or later part of the distance had to be covered by mule, and that meant usually going over two or three "high places," which in Peru signified at least 14,000 ft. above sea level. Today the mule still figures in many a trip, but so also does the airplane, and what the latter does seems absolutely incredible to us old-timers coming back again to Peru after a lapse of a dozen years. For example, not far from where this letter is being written a plane makes six to seven round trips a day, carrying a ton and a quarter each trip and taking twenty minutes to make the one-way trip, in constant wireless communication with one of the terminal ports. That same trip by mule takes just three and a half days.

A Pioneer

Twelve years ago I was one of the pioneers in starting things at the Pataz mine of the Northern Peru Mining & Smelting Company, out beyond the Marañon River, and that was considered a trip into the real hinterlands. Carrying in machinery and supplies by plane was considered at that time, and Elmer Faucett was asked to come out and look over the ground and the proposed landing field. He had a comparatively short time before made his exploratory flight from Lima to Iquitos, and that in those days called for the venturesome spirit. He came out to Pataz on a mule, and swore that it was his first and would be his last trip on any such dangerous means of transportation, and he meant it. Of course he wanted to see the mine, after that long trip, and access was then by a long crosscut. After some two hundred meters' walk through the crosscut he had enough, and said he didn't want to see anything more underground, and thereafter would stick to the safety of the air.

Today Faucett has a considerable airplane business, with a dozen or more "boats" that fly daily north and south, and he is credited with having carried more passengers and more mail, more freight tonnage, leaving out the some seven hundred tons carried by plane into Cotabambas, than any other of the three airplane lines at present operating in Peru.

Soon after my arrival in Lima I was awakened one Sunday midnight by a telephone call. Could I be ready to take a seat in a Faucett plane next morning at 8, if a seat was to be had? The result was that we left at 8:30 o'clock and, after stops in Canete, Chincha, and Pisco, dropped in at Ica, 180 miles away, at 10:30 and after a leisurely lunch left in auto for Saramarca mine, 72 miles southeast. Most of the way was over arid desert land with no made road—just tracks to follow made by the passing of some car a short time previous, for the wind-blown shifting sands soon cover any old tracks. Later the road reaches hilly ground and much of the way thereafter is cut out of the solid rock.

Saramarca mine was promoted mostly by Dr. McCornick, of the Bella Vista Hospital, near Lima, and H. L. Woodhouse, manager of the Peruvian Trading Corporation. The mill equipment comprises a jaw crusher over the bin; then a wall-type feeder into an Allis-Chalmers ball mill 6 ft. in diameter by 5 ft. long, in closed circuit with a Dorr Simplex SSF 4x20-ft. classifier, there being a single-cell jig between mill and classifier for the removal of coarse gold. Then follow a 30x10-ft. Dorr thickener, then three Devereux agitators in series, each 16 ft. in diameter by 12 ft., a second 30x10-ft. Dorr thickener, and a Moore filter. Precipitation is in a 125-ton Merrill-Crowe simultaneous clarification-precipitation plant using the small-size leaves in the clarifying tank and barrel-type zinc-dust feeder. Precipitate is melted in a tilting oil-fired furnace. Power is supplied by a diesel plant capable of producing excess power over that required by mill and mine. The mill was built by George R. Tingle and is rated at 50 metric tons' nominal capacity, but it has put through as much as 90 tons. Between 70 and 80 tons is the average daily capacity.

The Camp Comfortable

The mine is in an arid or semi-arid region. It has a well-built camp with comfortable quarters and modern sanitation, and an ice-making refrigerator. Cerro de Pasco engineers had examined this mine at one time and found the average value of the ore to be nearly an ounce. Some of the gold is coarse, almost as large as a medium-size pea in the largest pieces taken from the jig screen. There is practically no sulphide mineral in the ore, the jig concentrate being mostly iron from the balls and liners of the mill, some coarse quartz, and gold. Very high assays were reported from the mine before the mill started up, but after it went into operation the heads dropped to 7 to 9 grams per ton. Tailings went to one gram and even lower, so that recovery of gold was good. I was told that to avoid dilution the vein was not mined for the full width. That gives one pause for thought. I know veins in Southern Peru from which ore is taken rich enough in gold for the owner to work sorted ore in *"quimbaletes."* I could find no gold *in* the quartz, or at best only low assays; all the gold was plastered on the quartz between the vein and the wall.

From Saramarca it is a ride of an hour and a half by auto over to the town of Nazca, all through desert country, which would be some 60 km., or 36 miles, then half an hour farther to the Nazca or "Sol de Oro" mines, a property in which Hector Boza and Dr. Alfredo Alvarez Calderon are interested. Hector Boza was at one time owner of the La Guardia property, near Salpo, a silver mine that he sold to the Northern Peru for a million dollars, and now he is Minister of Fomento, and I must remark, as is the custom of everyone in Peru to add, for the second time. Dr. Calderon has been president of Northern Peru ever since the company was founded.

The ore from the mine is oxidized and carries copper in the form of chrysocolla. Some 200 tons per day can be treated in the mill, but at the time of my visit only 150 tons was being milled daily. The ore was expected to run 9 or 10 grams of gold per ton, but has been somewhat better than that—up to 15 to 16 grams per ton. From the mine it comes down to the mill over a cableway, dumping into a receiving bin, from which it goes to a 24x10-in. jaw crusher and thence into the main ore bin. There are two 6x5-ft. Allis-Chalmers ball mills in closed circuit with 4 ft. by 19 ft. 8 in. Dorr Duplex DSFU classifiers. Thence the pulp goes to a 42x12-ft. Dorr thickener, three Dorr agitators in series, each 22 ft. in diameter by 20 ft., and thence to a second Dorr thickener and into the Moore filter. Tailing is hoed out of the last filter compartment into a car and trammed to the dump, as is the practice also at Saramarca. The Merrill-Crowe plant has a full-size, or 6x4-ft., leaf clarifying filter, a 3 ft. by 8 in. vacuum tank, a belt-type zinc-dust feeder, and a 50-bag precipitate filter.

Diesel Power—Rotary Compressors

Power is supplied by a diesel engine plant, which at present barely meets the demands of mine and mill and is to be enlarged with two additional units. Rotary compressors are used for both the filter blow-off and the agitator air lift. The copper in the ore causes the solution to assay up to 0.40 per cent copper. Precipitate is melted in an oil-fired tilting furnace.

The Nazca mill is well built, after designs of Hector Boza's engineer, Andres Salas, who also built the La Guardia mill, at Challacocha, and is characterized by simplicity of layout and cleanliness that seem to mark all Salas' work as distinctively as the mills designed by Kenyon Burch bear the distinctive mark of their designer. And the same can be said of the Nazca camp, with its small cottages for the married officials, and a fine large hotel for the single men and transients, having an oil-fired kitchen stove, and a

show-case refrigerator such as one sees in many a shop in the United States, and out of which can come, and does come, served by Mercedes, who used to cater at the manager's house in Samne of the Northern Peru, the coldest beer and best cheese sandwiches ever served in a hot arid country after a day's long hike about the plant. Then there is a second hotel or guest house for directors and the other "brass hats," with every comfort and convenience to be found in any mining camp large or small anywhere in South America. All that bears the stamp of Hector Boza; reminiscent of his La Guardia days.

Cia. Aurifera Nazca, operating the Sol de Oro mine, in its report for the first half of 1936, states that though the mill was actually started up in January, 1936, it was not until February that it could be said to have entered into regular production. Thence until June 30, 21,370 metric tons of ore was treated, for a production of 215 kg. of gold, valued at S/945,366, from which was deducted S/406,579 as expenses and S/203,395 as amortization and reserves, leaving a net balance of S/335,392 (S means soles). The company therefore declared a 10 per cent dividend on its 250,000 shares at S/10 per share. Gold recovered amounted to S/44.24 per metric ton. Costs were: Mining, S/7.73; ore treatment, S/6.40; general, S/3.29; government taxes, S/1.61; a total of S/19.03, plus S/9.52 for amortizing cost of development, depreciation of installations, mine depletion, and reserve for renovations, or a grand total of S/28.55 and leaving a net profit of S/15.69 per ton of ore. The power plant was increased by the addition of two 450-hp. units of diesel electrics, bringing the total diesel power of the plant to 1,500 hp. A 140-hp. compressor was added, bringing the total to 240 hp., or 1,500 c.f.m.

Desert Flying

The flight back to Lima in trimotor Ford planes was over that dry desert which I crossed in auto but from the air one could look down upon great triangular spaces freed of every last stone, with bordering paths as straight as if laid out by transit, with here and there a similar rectangular area instead of the more common triangle. What relics these are of an Incaic or pre-Incaic civilization no one seems able to even guess. Advancing wind-blown sands have probably obliterated everything—whatever it was — that once existed between these paths.

Up northeast from Cerro de Pasco at Huachon, the Compañia Minera Nacional has a flotation plant, the concentrates from which are sent by auto to the Cerro de Pasco smelter at Oroya, and so far the ore sent to the mill is mostly from development work on a number of veins that have promise of interesting developments.

The Nacional company has just published its third report, dated June 30, 1936. Concentration in the mill, by flotation, was started May 14, 1936. The hydro-electric plant has a ditch 2,500 m. long for 1,700 liters of water per second capacity, and a penstock 574 m. long with 225-m. drop. Two Turgo waterwheels develop 600 hp., each direct-connected to Westinghouse generators. Transmission is at 460 and 6,600 volts. Total capacity including the older installation is 1,360 hp. The flotation mill has a capacity of 150 tons daily and with the coarse crushing a total capacity of 500 tons. New compressors have been added, of 1,500 c.f.m., so that total air capacity is now 2,300 c.f.m. or 272 hp. A cableway of 20 tons' per hour capacity is being installed between the Chipa mine and the concentrator. The two mines actually producing have blocked out 170,000 tons positive and 150,000 tons probable ore, and three other veins are being developed, the ore at present in which brings the total tonnage up to 200,000 tons positive and 180,000 tons probable.

A Comparison

In the old days when one wanted to go up into the Pataz region he first had to await a boat from Callao to Salaverry, and that boat might go direct in one day or it might be a *calatero* that lazied along from one little port to another for as much as three days before arriving at Salaverry. Then there was a train ride to Trujillo, then an auto trip out to Samne, then the mules. The length of the auto road increased little by little, out to Quiruvilca and finally to Huamachuco, to which town the auto now goes in seven or eight hours, before one has to take to the mules, and on in to Pataz requires three to three and a half days more.

Now the larger boats no longer stop at Salaverry, and the coast boats get little freight. Most of the freight goes from Lima to Trujillo by auto-truck and over a desert road rough and hard and dusty, but it gets there in three days. Passengers fly, and there are three different lines of planes, with at least one plane each way every day, and seats are not always to be had in any of them. The flying time is three hours and fifteen minutes.

From Trujillo one flies in to Lake Piaz which from the plane and on the map is just around the corner from Pataz, but it is a good day's ride, or even a little more to go around that corner on a mule. At some time a slip of land occurred across the narrow valley damming the waters of the Alpamarca River just above its confluence with the Marañon, thus forming Lake Piaz, and in the dry season at least the river bed above the lake is a wide and long stretch of gravel, all the water flowing to one side through a small channel. The "beach" makes an excellent landing field and there is a company engaged in carrying freight into the Parcoy region, operating one plane out of four owned, making two round trips between Trujillo and Lake Piaz daily. These are Curtiss Condor planes with two motors, and capable of carrying four tons, but as they at times have to fly as high as 15,000 ft., the usual load is three tons or slightly over, for which the contract rate is $85 per ton.

Leaving Trujillo these planes fly up the coast, thence strike eastward inland over agricultural regions that we miners do not begin to recognize until Usquil is reached, and there the old mule paths recall the plodding over them in former times, and now from the plane they do look steep and we understand how Faucett felt that time he came out to Pataz. Then soon we are over Huamachuco, then Cochabamba Hacienda (one day's ride by mule), then over Soquian Hacienda (another day by mule), then over there is Pataz, the Marañon River below, and straight ahead Lake Piaz, and, all too quick to have a good look, twenty minutes from Huamachuco and one hour and a half from Trujillo we are landed on the beach at Lake Piaz. It takes only 55 minutes to fly back over Huamachuco, then Quiruvilca, Shorey, Motil, Milhuachaqui, Samne, all old familiar places to former employees of Northern Peru.

Up a little stream 5 km. is Ariabamba, where Don Mariano Tarnawiecki has a little gold mine and a colony of fellow countrymen from Poland. Here with water power to turn his wheels he is putting up a 50-ton flotation plant and evidently intends to do some amalgamation before cyaniding his concentrate. He is just finishing a road to haul his machinery up from Lake Piaz.

The Parcoy Syndicate

Up the Alpamarca River 18 km. is Retamas, right close to Parcoy, where the Sindicato Minero de Parcoy has been working up to 1,500 men. This is a property in which Eulogio E. Fernandini, Jr., is interested. An auto road has been built up from the lake at a cost of 100,000 soles. Up to the end of July the company had spent a million soles on transport, two Condor planes a day from Trujillo to Lake Piaz, and a Ford tri-motor plane making six to seven round trips a day from Huamachuco and accounting for some 10 tons of freight daily. With four Ford trucks the company was for a time moving 25 tons of freight a day.

Parcoy has some good ore, high assays being as much as 250 grams per ton, these from the heavier pyritic

ore. Some stopes average around 50 grams, and mill heads are expected to run about 20 grams—maybe even 25. A 300-hp. hydro-electric power plant is in operation, giving light and driving four Ingersoll-Rand Type 40 compressors of 310 c.f.m. displacement each. A larger hydro-electric plant is being built, 1,200 hp., with a 45-cm. diameter penstock and 200-m. head.

The Parcoy mill will be of a nominal capacity of 200 tons per day, and may be enlarged by the addition of a second ball mill very soon, as it is said that the mine development already warrants going on to a 300 or 400 tons per day basis. The mill is expected to be ready to go into operation in November, and recent building progress would seem to warrant this. It is a splendidly built mill, a credit to the company and to J. T. Wynne, who is in charge of construction for the Allis-Chalmers company.

The course of the ore through the mill will be through a jaw crusher, then a Newhouse crusher, and thence into the fine-ore bin. Grinding will be done in cyanide solution, as at all the mills herein described where treatment is by cyanidation. The ball mill will be 7 ft. in diameter by 10 ft. long and will be operated in closed circuit with a large Dorr classifier. Then the pulp will flow into a 42x12-ft. Dorr thickener, then into three Devereux agitators in series, a second 42x12-ft. Dorr thickener, and thence to the Moore filter, of 30 leaves per basket, each leaf being 5½x10 ft. Merrill-Crowe simultaneous clarification-precipitation will be used. I am told that it is the intention to melt the precipitate down in an electric furnace.[1]

Timber Plentiful Near By

Timber will be required in the method of mining that is to be followed, and it is but a few hours' journey farther eastward into the *montana* country, where timber of many varieties is abundant. Already there is a road into the region. Tropical and semi-tropical forests supply a surprisingly great variety of woods. A kind to meet every condition for which lumber can be applied is apparently available.

The company is building comfortable and attractive quarters for its employees. Inasmuch as the region is around an elevation of 8,500 ft. above sea level, it is healthful, the days being comfortably warm and the nights chilly—cold enough for blankets on the beds and a fire a real need. A fireplace will be a feature in the living room of the staff house, in spite of a pretty general idea prevalent among Peruvian *hacendados* that a heated room is unhealthful.

A little higher up the road beyond Retamas and in the same Parcoy region is the little village of Soledad, and in this region Gordon Plews has mining properties. It is reported that he will soon start development actively on several of his claims and that he plans also to build a mill in the immediate future, but although he has recently made a trip into this district he has not yet had much to say about his plans.

Some 16 km. still farther along the road to the southeast is La Paccha, the mine camp of the Compañia Aurifera Buldibuyo Ltda., and just a mile or so above is the town of Buldibuyo. This property was operated by Pedro A. Anorga, who with a small Hardinge mill and a Wilfley table took out concentrates which he amalgamated to produce some gold. A company has been formed to take over the mine and build a mill, but Anorga remains the majority stockholder.

A fair amount of ore has been developed, hard quartz with 8 or 9 per cent pyrite of an average gold content of 19 grams, and, like the Parcoy ore, the richer it is in pyrite the greater the gold content, as a rule.

There is a fair prospect that the Buldibuyo mill will also go into operation in November at about the same time as the Parcoy mill. Much depends upon the arrival of freight, practically none of the mill machinery or construction material having been brought in by plane. It has all gone from Salaverry or Trujillo, 173 km., by auto truck to Huamachuco at a cost of $16.25 per metric ton. From Huamachuco to La Paccha everything has come in either on mule back or mounted on skids and dragged in by oxen, one of the heaviest pieces being a part of the Symons crusher that weighs 1,550 lb. The minimum freight rate for mule-back haulage is $43.40 per metric ton, and from that figure the rate ranges upwards, according to the class of freight and difficulty of hauling, to $260.40 maximum rate, with an additional $43.40 bonus per metric ton if not over twenty days has been taken in the trip from Huamachuco. The heavy piece of the Symons crusher was a special job for which a flat price was offered. The hauling includes crossing the Marañon on an *oroya* or floating the piece across the river on a *balsa* or sort of raft. Oregon pine costs $60 to $65 per thousand board feet in Salaverry, and by the time it reaches the mine represents an expenditure of 45c. or more per board foot.

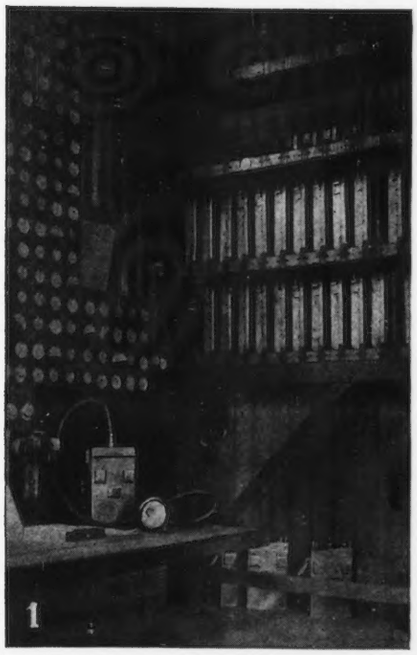
Ore from the mine will be trammed to the head of the mill and dumped on a 24-in. by 4½-ft. cantilever-type grizzly of adjustable slope and ¾-in. openings, the oversize going to a 20x10-in. Blake-type crusher and into a cylindrical steel bin 15 ft. in diameter by 16 ft. high. From there it will be fed by a wall-type feeder onto an 18-in. conveyor belt that will discharge upon an Aero-Vibe screen with ¼-in. openings, and the oversize will pass through a 20-in. Symons fine bowl crusher, the product joining the screen undersize upon another 18-in. conveyor belt that will carry it to another and similar steel fine-ore bin. A wall-type feeder will discharge from the bottom of the fine-ore bin upon an 18-in. conveyor belt that will feed the ball mill, a 6-ft. diameter by 22-in. Hardinge mill grinding in cyanide solution and in closed circuit with a Dorr classifier. The classifier overflow will go to one 14x10-ft. and one 20x10-ft. Dorr thickener, thence into a 16x12-ft. Devereux agitator, and then into two 12x10-ft. Dorr agitators in series, the discharge from the last of which will meet low-grade and barren cyanide solutions coming from the filters as washes or from the Merrill-Crowe precipitation unit, and flow into two Dorr thickeners of the same size as those ahead of the agitators. Filtration will be done in a four-tank Moore filter with baskets of fourteen leaves, each 5½x10 ft. The Moore filter vacuum pump and the blowing-off air compressor will be No. 34 and No. 24 Allis-Chalmers rotary types respectively. Precipitation will be by zinc dust in a Merrill-Crowe simultaneous clarification-precipitation plant that eventually will have a capacity of 200 tons of solution per day. Precipitate will be melted in an anthracite-fired crucible furnace, as good coal can be obtained from Sihuas, 80 km. away, and brought in on mule back or on burros for general heating and assaying as well as for precipitate melting. The nominal capacity of the mill is 50 tons, but it is expected to equal Saramarca mill performance.

Power From the Sitio

The company has already built a hydro-electric plant on the Sitio River 6 km. distant from the mine, the plant comprising two 75-kva. generating units transmitting current at 6,600 volts that is stepped down to 220 for motor and lighting use. Another plant, of 60 to 80-hp. capacity, is being built now right at the mine, and later a plant will be built farther down the Sitio River, in two units of 250 hp. each, only one of the units having so far been contracted for, and the second to be provided when and if needed.

Buldibuyo is the most remote of the properties that have been mentioned, and it is also the highest, say 10,500 to 11,000 ft., and is consequently cold pretty much throughout the year, in the nights ice forming over thin spills of water. On the whole it is healthful, and one has at least to be thankful that he is away from malaria, verugas, mosquitoes, and other pests, insects and otherwise. Enough water is available at the millsite to carry away the tailings from the Moore filter, in which respect Buldibuyo has an advantage over all the other mills here described.

[1] An electric furnace used in New Guinea by Bulolo Gold Dredging Company is described on pages 625-6 of this issue in the article entitled "Speed in Gold Melting."—The Editor.



Electric Cap Lamps In a California Mine

Prove Cheaper And Have Advantages Over the Open-Flame Light

John W. Chandler
Mine Superintendent
Lava Cap Gold Mining Corporation
Nevada City, Calif.

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1 EACH BATTERY has a number which corresponds to its location in the rack, and the small tags hung on the board are marked with that number and the miner's name

2 THE BATTERY RACK is conveniently located near the shaft, so that all the men check out their batteries and lamps before going underground and return them at the shift end. The lamp and battery standing on the table weighs about 5⅓ lb.

3 CAP PIECES AND CORDS hang on a rack which permits simple checking with the man's battery number and name. The back of each battery is provided with two metal slits which permit attachment to the wearer's belt

THE battery cap lamp used at the Central mine of Lava Cap Gold Mining Corporation, situated near Nevada City, Calif., consists of a small alkaline storage battery to be carried on the miner's belt, a transmission cord from the battery to the lamp, and a high-candlepower electric lamp to be attached to the hat of the miner. This lamp has two filament bulbs, one filament being the regular or "high" light which will burn at full brightness for twelve hours or more without recharging the battery, and the other a somewhat smaller filament to be used in case of a burned-out high-light filament. The battery is a three-cell nickel-iron-alkaline type in a sturdy container, which is ingeniously locked when the cover is attached, and can be released only by the use of a magnetic key that disengages two dogs locking the cover from the inside. As a consequence, tampering with the battery on the part of the men is reduced to a minimum. The entire lamp weighs 86 oz., or about 5⅓ lb., the cap piece weighing only 6 oz.

Early in March, 1935, ten electric cap lamps were received and issued to the men at the Central mine. Three of these lamps were equipped with spotlight reflectors and were given to the foremen. The other seven lamps were fitted with the regular floodlight reflector and were distributed among the men. After this crew of men had used the lamps for a few days, they were passed on to others for trial. This went on for some time, until most of the crew had had the opportunity to try one. The general opinion of the men was that the battery weighed too much and was too cumbersome to carry about, and that the cord hanging down their backs was an objectionable feature.

The foremen, however, were well satisfied with the lamps, and suggested to the management that the men try them for a longer period of time to see if it were not a question of getting used to wearing them. At their suggestion,

the management gave the lamps to the seven men most opposed to their use for a trial to last two weeks. At the end of this period most of the men had been won in favor of them, and it was deemed advisable to test other men in the same manner.

In June, 1935, a hundred of these lamps went into service, and twenty more lamps have been added since that time. All are rented from the Mines Safety Appliance Company at a fixed rental charge per month. The company also supplies charging racks and control panels as well as a complete stock of spare parts. At the end of the six-month period, it was found that the total cost of these lamps, including labor in attendance, electrician's time, rental, power consumption, and depreciation, was 5.85c. per man-shift (Table I). Carbide delivered to the shaft costs 2.54c. per man-shift (Table II) In other words, the electric lamps cost more than the carbide. To make a fair comparison between carbide and electric lamps, all factors in their respective use underground had to be considered. To offset the difference in cost, there was the fact that the men had a better light to work with, which meant added efficiency.

From the best information available, it is shown that a carbide lamp with a polished reflector and a flame 1⅛ in. long will deliver 25 beam-candlepower. The same lamp with a tarnished reflector will deliver only a 4 beam-candlepower. According to information received from the manufacturer, the flood type of reflector in use at the Central mine delivers 65 beam-candlepower, from 2½ to 16 times as much light in the beam as a carbide lamp. The average open-flame lamp reflector used by the miner is usually tarnished, whereas the electric-lamp reflector is at all times bright because of the fact that the headpiece is moisture-proof and dustproof. The spotlight reflector used by the foremen is said to deliver a maximum beam-candlepower of 1,200, or better than 48 times that of a carbide lamp with a polished reflector.

Another important advantage that must be taken into consideration is the safety element of the electric lamp. The better light afforded by this lamp enabled the miners to size up their working places more quickly. The need for timber under bad ground and barring down was apparent sooner than with the carbide lamps. At the Central mine a cut-and-fill system of stoping is used. Ore is sorted out in the stopes and the waste used for fill. Since the employment of electric lamps it has been found that a better job of sorting was being done, with cleaner ore as a result.

Men naturally work with less effort when supplied with abundant light. Tools are more readily seen when needed. Movements are sure, and men are able to move more actively. Carbide lamps are at times in need of water, carbide, and reaming out of burner tips. When a man is in need of water, he usually interrupts a machine man to get it. A man refilling with carbide or adjusting the burner tip will call on his partner for light to see what he is doing. These actions call for "time out," not of one man but of two.

During a safety meeting with all men, at which electric lamps were the topic of debate, many interesting and important facts were revealed. Safety and operating points were discussed and voted upon to determine exactly what the men thought of the lamps. All agreed that time was saved during the shift by not having to tend carbide lamps. A vote was taken, and it was found that 17 per cent thought 15 minutes per shift were saved; 69 per cent thought 30 minutes per shift was a fair figure; and 14 per cent of the men thought it was closer to 45 minutes per shift. A weighted average showed that the men thought they saved about 30 minutes per shift. The foremen, taking into account other factors that the men were prone to overlook, set the time saved per man-shift at 1 hour. By averaging these two figures it is estimated that a total of 45 minutes is spent by a man rejuvenating his lamp, together with its attendant diversions. This waste of time is not altogether eliminated, as a man naturally wastes some time during a shift, but it does reduce the number of opportunities for doing so.

The cap piece of an electric lamp weighs 3 oz. less than the average burning carbide lamp. There are no fumes from leaking gaskets or dumped carbide. Minor burns suffered from carbide lamps are absent, and men report that the electric lamps are not a hindrance to them in their work. The complaint that the battery was too heavy has been forgotten. Many adverse comments would be heard if the electric units were again replaced by carbide lamps, for, by actual vote, 98 per cent of the men decided in favor of the former, and wasted no time pointing out their advantages.

It is felt that the safety element is an important one. Safer working conditions mean fewer accidents. Loss of time and compensational accidents are difficult to compute in actual figures, but the saving in this regard is real. One serious accident is called to mind that could have been prevented had electric lamps been in use when the mishap occurred.

In addition, the electric lamp eliminates some of the inherent hazards of the open-flame lamp as follows:

1. It forces the men to blast their rounds with "spitters." When spitting with carbide lamps there is always a danger that particles of powder will plug a burner tip and leave men in the dark with split fuses.

2. It eliminates entirely lamps being blown out by concussions from blasting.

3. There is no possibility of a man's cap lamp accidentally igniting a fuse

Table I—Cost per Lamp-Shift—Electric Lamps

Labor: (Lamp attendant)	(*a*)	$0.0218
(Electrician)		0.0047
Rental		0.0304
Power consumption	(*b*)	0.0007
Depreciation (*c*)		0.0009
Total		$0.0585

(*a*) See Table III. (*b*) See Table IV. (*c*) On motor-generator set and still for battery water.

Table II—Carbide Consumption

1935 Month	Lb. Used	Av. No. Men per Day	Work Days per Month	Man-Shifts Worked
Jan.	1,300	80	30	2,400
Feb.	1,000	83	27	2,241
Mar.	1,000	87	30	2,610
Apr.	1,200	91	29	2,639
May	1,200	89	30	2,670
June	Started to use electric lamps.			
Total	5,700			12,560

Cost of carbide f.o.b. mine, $105.15 per ton:

$$\frac{5700 \times 105.15}{2000 \times 12560} = \$0.0239 \text{ per man-shift.}$$

Cost of Carbide per Man-Shift

Cost of carbide	$0.0239
Attendant (*a*)	0.0015
Total	$0.0254

(*a*) Equals 15 minutes a day by top man.

Table III—Electric Lamp Attendant—Time for Average Week

Time required to: Issue Lamps to Men, Minutes	Receive Lamps from Men, Minutes	Miscellaneous Time Required, Minutes	Total Time Required, Minutes
130	80	10	220
130	90	10	230
140	90	20	250
150	100	10	260
150	90	10	250
130	80	20	230
140	(*a*)135	40	315
Total			1,755

Total time required per week, 29 hours and 15 minutes.

(*a*) Extra time devoted to watering the lamps once a week.

Attendant's wages @ $5.00 per shift:

$$\frac{29.25 \times 5.00}{7 \times 8 \times 120} = \$0.0218 \text{ cost per lamp-shift charged to attendant.}$$

Electrician's wages @ $6.30 per shift, charging 5 hours per week to racks:

$$\frac{5 \times 6.30}{7 \times 8 \times 120} = \$0.0047 \text{ cost per lamp-shift by electrician on 120 lamps.}$$

Table IV—Power Consumption for Charging

Six racks of batteries—20 to the rack
Set requires 2 amp. at 120 volts
Charging rate, 2 amp.; charging voltage, 6 volts
Equivalent to 12 watts per battery per hour
120 batteries at 12 watts = 1.44 kw. per hour
Eight hours' charging at 1.44 kw. = 11.52 kw.-hr.
Power rate @ 7¢ per kw.-hr. = $0.08064

$$\frac{0.08064}{120} = \$0.00067, \text{ cost of power per battery per shift}$$

in a round overhead without his knowledge.

4. The hazard of heat around caps and fuse is eliminated.

5. It eliminates open-flame lights around powder magazines and in the cutting and handling of powder and primers.

6. Mine fire hazards are considerably reduced.

At present each man has his own lamp, with a number on the battery case which corresponds to a like number in the charging rack. To check on the lamps, tags bearing the man's name and his lamp number are hung on a board in the charging room. By this means the shift is checked in and out. A battery missing from the charging rack can be traced immediately to the man to whom it belongs. This check system also prevents the possibility of leaving a man underground for long after the shift is out.

To summarize briefly, carbide delivered to the shaft collar costs 2.54c. per man-shift. The total cost for using electric lamps is 5.85c. per man-shift. A close study of all factors involved points out that at least 15 minutes a shift or its equivalent can be saved by the use of electric lamps. This time equivalent at the present wage scale amounts to about 15c. per man-shift. Add this to the cost of carbide delivered to the shaft and the figure 17.54c. per man-shift closely approximates the cost of using carbide underground. By these figures, carbide lamps cost three times as much to use as electric lamps, the saving in favor of the latter being more than 11c. per man-shift. At present this reflects itself in a total saving of more than $13 per day. Savings resulting from accidents and better ore sorting are difficult to ascertain, but it is believed that the preceding figure is conservative.

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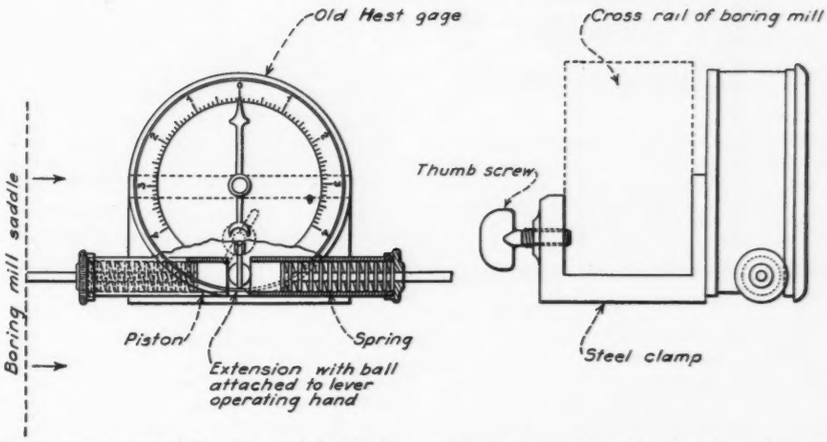
Boring Mill Indicator Simple in Design

INTERNAL WORK done in a boring mill, as for instance the reconditioning of valve seats in pump chambers and diverse repairs on large compressor parts, is often a time-consuming job when lacking proper control devices, writes John Kraetz, foreman at the machine shop of Phelps Dodge Corporation, Copper Queen Branch, Brisbee, Ariz. To insure correct measurements and avoid spoilage of parts, operations must be interrupted at frequent intervals in order that the work may be inspected and measurement taken. This is particularly true when cutting a recess for a valve seat or some other pump auxiliary. In addition, the operation is unsafe and many an injury to the eye and hand has resulted during the advancement and retirement of the cutting tool and inspection of the machine part while the table of the mill is in motion.

The homemade indicator shown in the accompanying sketch has simplified matters considerably for the boring-mill operator and has eliminated much of the guesswork done previously. It is simple in design and made entirely



from scrap material. As explained, the device consists of an old Hest gage with two soldered-on machined cylinders, each containing a small piston and a spring, and a steel clamp attached to the back of the gage. Two end caps serve as guides for the feelers extending from each piston.

The manner of operation is relatively simple. After the indicator has been secured to the cross rail of the boring mill at a predetermined point, the machine is set in motion and the advancing saddle holding the spindle with its cutting tool presses against the feeler extending from the piston and actuates the indicator mechanism controlling the hand on the dial. The operator of the mill can thus read the exact advance of the tool without stopping the mill and wasting time in taking needless measurements.

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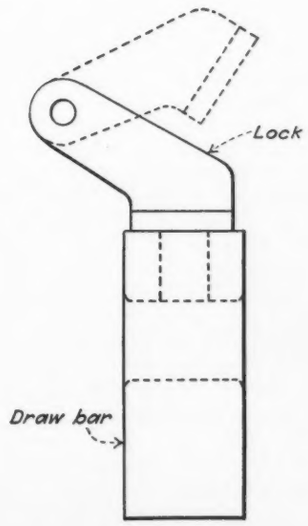
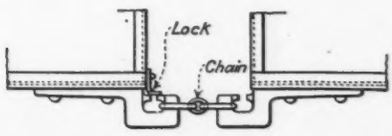
A Novel Car Coupling



AN INNOVATION at the mines of Anaconda Copper Mining Company, Butte, Mont., that has materially reduced mine car maintenance costs is the simple coupling explained in the accompanying sketch. The new method of coupling mine cars differs from standard practice in that no use is made of flat-iron bars and steel pins, the connection between the two drawbars being made by a short chain. Use of this auxiliary gives additional flexibility to the coupling, permits quicker coupling of the cars, and eliminates injuries to hands, as the operator can easily slip the end link of the chain over the drawbar head without exposing his fingers or hands to the drawbar ends.



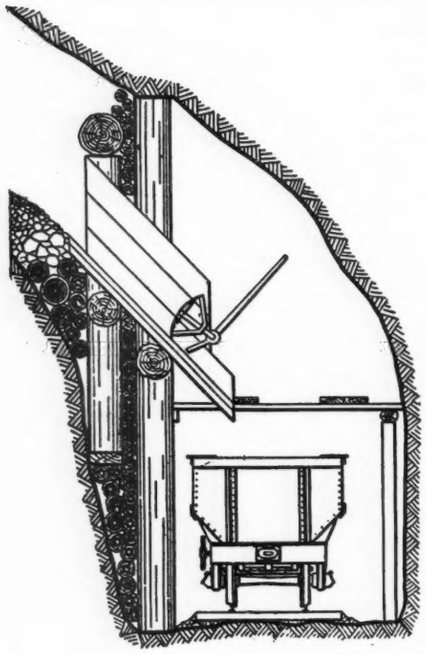
The chain consists of three links and has a total length of 12¼ in., measured on the inside of the two end links. These are made from ¾-in. round steel; and ⅝-in. material is used for the center link. The steel drawbars are hand-forged and are riveted to the car bottom. Although it is practically impossible for the chain to slip off the drawbar heads, each car is provided with the simple lock shown in front view in the first column. It is made from strap iron and operates like a common latch.

Granby In Retrospect

A look backward to the mining problems that confronted the company and the contributions made to the industry in solving them

C. M. Campbell

502 Pacific Building, Vancouver, B. C.



ORE CHUTES in the old Phoenix mines were started by breaking two complete rounds and the cut holes of the third. The inside posts were sometimes lined with steel plate and the platform was ample for two men to load the 10-ton mine cars

BETTER CONDITIONS in an industry usually account for changes in plans and policies of companies. On Jan. 23 this year stockholders of the Granby Consolidated Mining, Smelting & Power Company, Ltd., of Canada, approved a plan for voluntary dissolution. On Sept. 29, however, they voted to halt liquidation and resume operations at the Allenby property. In its mining career of 40 years this company has played an interesting part in the revolution of mining methods that began early in the century.

Following the construction of the Dewdney Trail through the southern part of British Columbia, prospecting was given a great impetus. During the 'nineties finds were made and claims staked which afterwards resulted in important mining activity in that belt, which contains such well-known places as Rossland, Velvet, the Boundary, Camp McKinney, Hedley, and Princeton. In the Boundary district the chief claims in the different camps were staked about 1896, numerous companies were incorporated, much development was done, and large tonnages were blocked out. In 1901 a group of companies holding adjoining properties were consolidated under the name given in the foregoing, and in that year shipments were made from these mines in and about the newly incorporated city of Phoenix to the newly constructed smelter at Grand Forks.

Mining costs in the first year averaged $2 per ton. That year also disclosed the very important fact that though high-grade ore could be mined, the supply was small. In fact, the tonnage of ore that could be mined at any profit was small. There were, however, millions of tons of marginal and submarginal grades that would be available if costs could be reduced.

In a general way the orebodies were found along the sides and bottom of a saucer-shaped mineral zone over a mile in diameter. They were, therefore, steeply inclined to flat lying and they varied in size from deposits containing a few thousand tons to the largest, which contained about 9,000,000 tons. A large tonnage of the ore could be cheaply mined; for much of it, however, there was a heavy development charge and an appreciable mining and handling handicap.

In those days square-set stoping was the widely used method of ore extraction, and Granby operations were started on that basis, with a cost for labor and timber that was prohibitive for low-grade ore. There were, however, places in the world, such as the Michigan iron mines and Alaska Treadwell, where square-sets were not used. These methods were looked into and a somewhat similar system was devised.

The plan of operation was to block out the ore on the levels with drifts and crosscuts. A raise for ventilation would then be put through to the next level or to the surface. A series of these raises would then be put up, all connected at regular intervals. The ore would then be taken out from the foot to the hanging wall, leaving a series of pillars. These would then be gradually removed.

In many areas recovery was complete. In one area 400,000 tons were removed, the roof remaining intact for some time before it caved. In another area a stope, roughly circular in shape and 250 ft. in diameter, had its roof supported finally by five pillars. These were all blasted at once, leaving a perfectly good roof that had not caved some years later when the mine was closed. In some cases where caving of the roof would affect surface roads or buildings the mined-out area was filled with waste rock. Often fine material could be flushed in with water, making a strong support. Raises could then be put up in the remaining pillars and the bulk of the tonnage removed.

The mine chute as finally worked out is shown in the drawing. In starting a raise two complete rounds were broken down and mucked. A third round was drilled, but only the cut holes were blasted. The timbers were then put in as shown in the sketch. The chief features were two vertical posts, which generally lasted for the lifetime of the tributary ore. Inside were two shorter posts and a cap, all often reinforced with steel plate. The inside posts and cap took the rough usage from the blasting and could be easily renewed if necessary and replaced. A steel gate operated by a lever controlled the flow of ore.

A platform was erected for the chute crew, consisting of one man on the lever and another with a pinch bar. The chute had a 3-ft. opening. When completed the side holes were blasted, and as they threw the rock to the sides the timbers were rarely injured. Ore was then left in the chute to cushion the effects of later blasting. Mucking was therefore cut down to the shoveling on the sill floor and two and a half rounds of broken rock from the raises.

When necessary, as when a raise went through waste for some distance before reaching the ore, manways were driven up beside the raise and broken through where needed. This would give access so that the raise could be cleared should it hang up. Large boulders that would not go through the chute could also be drilled and blasted from above if desirable. This type of raise later developed into the bulldozing chamber in some of the large mines.

A 3-ft. opening meant that large muck had to be handled, and 30 years ago this was not being done to any extent. However, costs had to come

PENETRATING INTO OLD STOPES, the sunlight sharpens the pattern of numerous ore pillars which remained in the early days, but since have been removed

down, an output of over 4,000 tons per day was being planned, and the small 1-ton capacity cars, with the then famous Anaconda axles, pushed to the station and caged by hand, were not equal to the task. Horses had been introduced in some parts of the mine previously, but even this improvement was out of line with the demand.

Search revealed the fact that a 10-ton capacity, 3-ft. gage, hopper-bottom, steel car, shown in the sketch of the mine chute, could be obtained in Pittsburgh, and cars of this type were therefore introduced. As electric power was limited, coke-burning locomotives were used on one of the main upper levels where ventilation was good and electric locomotives were used elsewhere. With the provision of ample electric power, everything possible was placed on an electric drive.

THIS 1907 MODEL CAR in the Phoenix mine was the first design of the well-known Granby car. Other designs followed later and were successfully installed to suit various mine conditions

A chute that would deliver a 3-ft. rock meant extensive alteration to the bin chutes and new crushers entirely. Various gates were devised for the chutes leading from the bins to the crushers, but the most satisfactory was the finger gate shown in the accompanying cut.

In some parts of the mine the ore was magnetite, not only hard but tough, and this fact, with the large size of the muck being handled, demanded crushers of sturdy construction. The result was that four crushers of the Blake type were installed at different outlets, for there were essentially four different mines in this operation. These crushers had a frame weighing 31 tons, a swing jaw weighing 8 tons, and a 2-ton pitman. Manganese-steel jaws were also introduced about that time, and they helped to cut down crushing costs. Anything, therefore, that could be delivered to the crusher was broken down to 6 in., the maximum feed for the smelter.

Special attention was given early to the mine tracks. From the most remote part of the mine to the crusher was a distance of well over 3,000 ft., and considerably over a mile for the round trip. Anything that would help a safe and speedy service was introduced. Three-foot gage tracks with 30-lb. rails were therefore used on all levels, with 56-lb. rails outside on the trestles. Grades were reduced, curves were laid out with the instrument and they were banked, split switches were installed, and to see that the work was properly looked after the best section men available were obtained from the railways.

I have referred to the 10-ton capacity cars which were introduced. Though perfectly satisfactory for medium-sized ore, they were unsatisfactory for the larger material. The ore would hang up in the cars, and the procedure was then for the brakemen to work with pinch bars until the jam was broken. This took up valuable time, and as sometimes the car could not be cleared in the time limit, the ore was blasted out. This often meant injury to the car, and as a result the repair gang was large.

This was a matter of concern to all, and finally the idea of an automatic side-dumping car was suggested. The details were worked out and a full-sized model was constructed that was satisfactory. The 400-ft. level was in 1907 equipped exclusively with cars of the type described, the original installation being shown in a photographic reproduction. These cars were found to be a great success, and they were then built in various designs for different conditions prevailing either at Phoenix or at other Granby mines. All subsequent installations were equipped with roller bearings and M.C.B. couplers. Smaller cars were built for 2-ft. gage tracks. For the glory hole, where an electric shovel was operating, and where very large waste had to be disposed of,

FINGER GATES operated by compressed air controlled the flow of broken ore from the bins to the primary crushers

10-ton capacity cars were constructed. These had free-swinging doors that would permit exit of large pieces of waste. To get rid of particularly large masses of waste, as large as the shovel could lift out of the way with cables, cars were constructed with doors that would drop automatically. It was soon found that no doors were necessary, and they were taken off, the car then being essentially an automatic side-dumping flat car. For finer and more sticky ore, cars were built with a dipping angle to the box of 45 deg., instead of 30 deg., the usual angle of dip.

The question of the proper type of car for a large mine is important. Some mines feature the rotary dump. This is an interesting and fascinating piece of mechanism borrowed from coal-mining procedure. At the coal mines a train of cars is delivered to the tipple, where they are disconnected, weighed separately, and each car then passes through the rotary dump and its contents are discharged. This method serves the coal mine admirably, because mining is usually on a contract basis and it is necessary that the individual car be weighed separately. This is not the condition in the metal mines, and the time taken to break up a train and dump each car separately means much time lost. To solve this problem some mines have constructed costly dumps that will take three cars at a time. However, as large mines often run more than twenty cars in a train, the time lost in disconnecting, dumping, and connecting is still large. The Granby type gets away from all this delay: The motorman simply slows up and the train is unloaded without even stopping.

In the Granby mines, however, speed was only one item. Millions of tons of waste were removed. This was dumped on the surface and in the stopes. With a cheaply constructed, easily removed, and easily set up dump block, the Granby type of car was found to be adapted to nearly any purpose. Repair costs, also, were very light, and when the mine was worked out the original installation was sold to the Sullivan mine and when last heard of the cars were still in service.

The result of these and many other minor improvements was that the mine cost, which in 1901 was $2 per ton, was gradually reduced, and in 1906 the figure stood at 97c., a cost that included a development charge of 17c. This was further reduced to 75c. in 1913, at which time the development charge included amounted to 12c. In that year one of the units produced ore at a cost of 53c., exclusive of development.

The ore was then faced with a transportation charge to the smelter of 25c. In that year the smelting, converting, transportation, refining, marketing, and all other charges were $1.65 per ton, making a total cost of $2.65 per ton of original ore. The tonnage treated in that year amounted to 1,227,544.

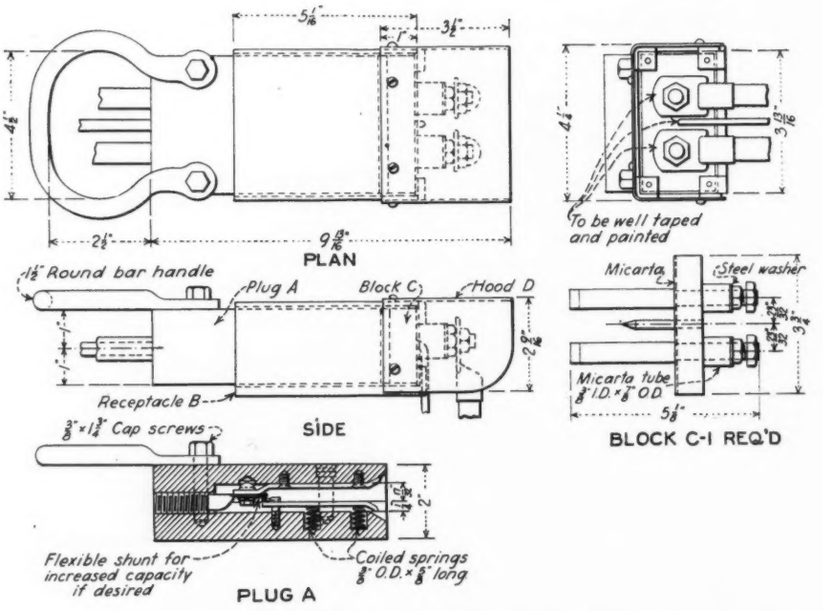
New Battery-Charging Plug, Safe, Efficient, And Low in Cost

CHARGING electric batteries is a comparatively easy task that can be performed by motormen without the aid of an electrician when dependable control equipment is available at the charging station. The charging plug in particular plays an important part in this work. Many a battery has been overcharged, with resultant loss of operating time or perhaps complete ruin, because of defective contact fingers and failure to thrust the plug completely into the receptacle.

In the conventional charging plug, contacts are maintained with cylindrical sections made from spring brass, the outer section of each being split to form tension fingers to carry the current in the power circuit. This feature, however, makes proper maintenance difficult, and as a consequence poor contact often results, causing burning and blistering of the contact fingers. Failure to remove these blisters impairs the contact, the plug cannot be thrust far enough into the receptacle, and the battery is subject to overcharge. Frequently, all tension is destroyed by contact finger sections being welded together by burning. Because of inaccessibility it is practically impossible to correct this defect, and as no part can be renewed, the plug must be discarded. In fact, any condition such as dirt, overcurrent, mechanical injury, or failure to insert the plug properly may render useless both the plug and receptacle.

William A. Hart, chief electrician, Copper Queen Branch, Phelps Dodge Corporation, Bisbee, Ariz., overcame the aforementioned difficulties by replacing the conventional charging plug with one of his own design shown in detail in the accompanying cuts. It can be made for as many contacts as may be required for any motor and power circuit connection, and all parts are accessible for renewal or repair. Contact tension is made by use of coil steel springs placed back of the floating contact. The springs carry no current, as is the case in other designs, and consequently have no temperature rise in them to lessen the contact tension. All parts carrying current are embedded in Micarta blocks, and the receptacle metal housing is made of cast bronze.

The new plug is safe and gives long positive contact in both power and contact circuits. Its cost is about the same as that of the old type. This cost, however, can be lowered materially by using molded insulator sections and pressed contact bars when making them in large numbers. The plugs made at the Junction shops required considerable machine work. Since 1932 more than 30 batteries, 17 locomotives, and 15 charging panels have been equipped with the new charging plug, locally known as the Copper Queen charging plug, which has proved to be both reliable and superior to the conventional type plug. The same principle can be used in designing an explosion-proof model often required on special equipment.



THE COPPER QUEEN CHARGING PLUG, here shown, has proved reliable and superior to the one of conventional type

ON THE SLOPE OF TYBO CANYON sets the headframe of Hale's shaft, the crushing plant, and the mill. The repair shops and general office are situated near the Ely-Tonopah highway. Men and supplies enter the mine through an adit behind the buildings

Tybo Improves Its Metallurgy

Better recovery now made from ore of this old district in Nevada

J. B. Huttl
Assistant Editor

DURING a recent trip through the principal mining districts of Nevada, I visited the Tybo mine of the Treadwell Yukon Company, Ltd. This property is situated in Tybo Canyon, a part of the Hot Creek range in the northeastern section of Nye County. Communication with Tonopah, the nearest railroad point and about 70 miles distant, is made over the Ely-Tonopah highway and a short gravel road, which winds through Tybo Canyon and joins the main highway at a point 6½ miles southeast of the camp.

As will be seen in the accompanying illustration, the mine and camp are in a fairly steep canyon with walls rising to heights of more than 1,000 ft. above the canyon floor. Altitude above sea level is 6,700 ft. The surrounding country is rugged and mountainous, and, save for occasional patches of piñon timber, is practically bare of vegetation. Warm and dry weather prevails during summer; and low temperatures with rains and snow occur during winter and early spring. The climate is typical of the Western desert regions.

The Tybo mining district is perhaps one of the oldest in Nevada, having been worked for its rich oxidized silver ores as early as 1869. Since then the properties in the area were worked intermittently by different owners, and the output was treated in a twenty-stamp amalgamation mill from 1872 to 1880, and in a flotation plant and lead smelter during the period 1917-20. The Treadwell Yukon Company, Ltd., entered the district in 1925 and after extensive exploration and development work, commenced to build the present 500-ton flotation mill in 1928. The first production was made in May, 1929. Milling operations were described in detail by H. M. Lewers in *E.&M.J.*, Vol. 130, No. 5, pp. 218-20, but as several changes have been made, particularly in the reagent set-up, since publication of this article, a brief sketch of present milling practice should be of interest.

The geology of the Tybo area is complex, and the rocks encountered include sediments of early Paleozoic age, from Cambrian to Silurian; a sedimentary, possibly Tertiary; and dikes, lava flows and sediments of probable Tertiary age. The material mined at present is an argentiferous lead-zinc sulphide ore with pyrite, sphalerite, chalcopyrite, galena, arsenopyrite, and pyrrhotite as the primary sulphide minerals. Ores above the 400 level are oxidized and both secondary mineralization and enrichment are evident. Some oxidation in the form of limonite and limonitic sludge extends as far as the 710 level.

Development consists of the Hales shaft, sunk by the present owners, and an adit through which men and supplies enter the mine. Production is hoisted through the Hales shaft in 2-ton skips. The mine has been opened to the 1,160 level, and plans are maturing for sinking the shaft another 150 ft. to the 1,310 level. Stoping operations are carried on west of the Hales shaft on the 800 level and considerable development work and diamond drilling are in progress in the eastern part of the mine on the 1,160 level. A diamond drill is also in operation on the 860 level.

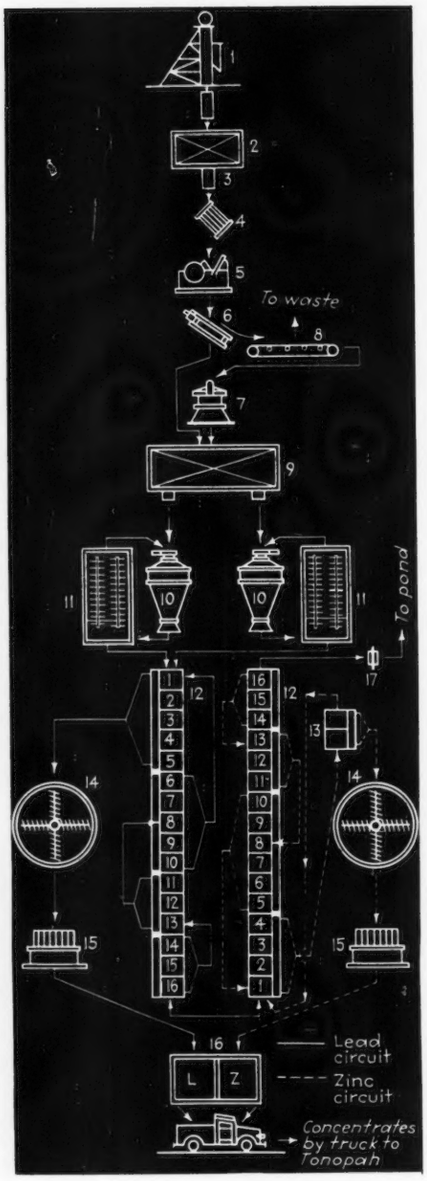
Developed ore is removed by shrinkage stoping. All air drills used throughout the mine are of the I-R type. The drills are made from 1¼-in. round steel. Broken ore is trammed to the loading station by Mancha and G. E. locomotives. The mine cars used underground hold 1 ton of ore. Diamond-drill equipment consists of a Mitchell drill capable of taking ⅞-in. cores. Water made by the mine amounts to about 600 g.p.m., which is removed by pumps on the 1,160, 1,100, and 860 levels, all discharging into the main sump at the old 2G shaft, from which either one of the main pumps lifts it to the surface. Timber consumption in the mine is inconsequential. The complete surface plant comprises well-equipped repair shops, a compressor plant, general office, change room, store, boarding house and two dormitories.

The mill is treating about 275 tons of ore a day at present. Save for the addition of a two-cell Kraut cleaner in the zinc circuit and rearrangement of the two classifiers, no major changes have been made in the mill equipment. The flow of ore through the mill and the machinery used are explained in the accompanying flowsheet. Primary crushing is done in a 30x18-in. jaw crusher adjusted to give a 3-in. product, which is fed to a Link-Belt vibrating screen by a 24-in. belt conveyor. Screen oversize goes to a slow-moving picking belt, where waste, wood, and tramp iron are removed, before entering the 4-ft. Symons cone crusher to be reduced to ½ in. The crusher product and the bypassed screen undersize go via a 20-in. belt conveyor, equipped with a Merrick weightometer, and a distributing conveyor to the 1,400-ton fine-ore bin. Two 8-ft. by 48-in. Hardinge ball mills operating in closed circuit with 6x25-ft. Dorr classifiers are available for fine grinding. This is done to complete 48 mesh, which gives 58 per cent minus 200 mesh. Finer grinding is found to result in sliming of the galena. The classifier overflow is at 44 per cent solids. The density of the pulp in the lead circuit is 38 per cent solids, and that in the zinc circuit 28 per cent solids. Reagents fed to the mills in pounds per tons are as follows: Na_2CO_3, 0.55 lb.; $ZnSO_4$, 0.4 lb.; and NaCn, 0.11 lb.

Classifier overflow goes direct to the sixteen-cell Minerals Separation flotation machine set aside for the lead circuit. Concentrate from the first five cells flows to a 24x8-ft. Hardinge thickener, and the froth from cells 6, 7, 8, 9, and 10 is returned to the head of the flotation machine, froth from cells 11, 12, and 13 to cell 8, and froth from cells 14, 15, and 16 to cell 13. Reagents used per ton of ore treated in the lead circuit are: Amyl xanthate, 0.05 lb.; cresylic acid, 0.17 lb.; Minerec B, 0.01 lb.; and sulphonated castor oil (turkey-red oil), 0.005 lb. Each reagent is fed to the respective cell by a specially designed rotary feeder.

After experimenting with various fatty acids, sulphurized pine oil, and other reagents, in an effort to reduce losses of slimed lead and semi-oxidized lead, and to recover as much middling as possible, of sufficient value to pay its way to the smelter, a soap emulsion was evolved which has proved highly satisfactory. Because of its sharp selectivity, the mixture is particularly effective on the oxidized and slimed portions of the ore. Economies in the consumption of cresylic acid and xanthates have also been noted.

In the zinc circuit, where high circulating loads of zinc, zinc middlings, and pyrite presented difficulties, use of the emulsion in the cleaner machine keeps the zinc cleaned up, especially when rather large amounts of lime are fed to the cleaner. The emulsion used in the zinc circuit is almost identical to the one fed to No. 6 cell of the lead-circuit flotation machine.



GRAVITY AFFORDS EASY FLOW OF ORE

from the shaft bins to the crushing plant and through the flotation plant. The capacity of the mill is 500 tons per day, but mine production at present is about 275 tons daily

LEGEND

1. Steel headframe with combination 2-ton skip and cage
2. 300-ton coarse-ore bin
3. 36-in. Link-Belt apron feeder
4. Grizzly, spaced 3 in.
5. 30x18-in. A.-C. jaw crusher, set to 3 in.
6. 3x8-ft. Link-Belt vibrating screen
7. 4-ft. Symons Cone crusher, set to ½ in.
8. Picking belt
9. 1,400-ton fine-ore bin
10. 8-ft.x48-in. Hardinge ball mills
11. 6x25-ft. Dorr classifiers
12. 16-cell M.S. flotation machines
13. 2-cell Kraut cleaner
14. 24x8-ft. Hardinge thickeners
15. 5 ft. 4-in.x10-ft. Oliver filters
16. Storage bin for concentrates
17. Automatic sampler
18. Trucks

Tailing from the lead circuit flows by gravity to a second sixteen-cell Minerals Separation machine, which constitutes the zinc circuit. Concentrates taken from the first four cells are retreated in a two-cell Kraut cleaner, and froth up to cell 10 is returned to the head of the flotation machine. The overflow from cells 11, 12, and 13 returns to cell 8, and froth from cells 14, 15, and 16 to cell 13. Cleaner concentrates go to a second 24x8-ft. Hardinge thickener, and the tailing is returned to the head of the zinc circuit. The underflow from both Hardinge thickeners is further dewatered upon 5 ft. 4 in. by 10 ft. Oliver filters before being transported by 18-in. belt conveyors to lead and zinc loading bins, respectively. The vibrating roll installed recently on the filter treating lead concentrates is giving very good results. Total reagents used in the zinc circuit, in pounds per ton, are as follows: Ethyl xanthate, 0.056; $CuSO_4$, 0.48; $Ca(OH)_2$, 1.7; and cresylic acid, 0.15.

In the lead circuit cresylic acid is fed to cells 1 and 8, and the amyl xanthate is distributed to each cell in graduated amounts from about 10 per cent of the total for cell 1 down to approximately 2 per cent for the last cell. Minerec B and sulphonated castor oil go to cell 6. Distribution of reagents in the zinc circuit is as follows: Lime and copper sulphate to cell 1, and ethyl xanthate is distributed as in the lead circuit.

Operating results are given in the following table:

	Silver, Oz. per Ton	Lead, per Cent	Zinc, per Cent	Iron, per Cent
Feed	11.02	6.8	3.48	14.8
Lead concentrate	81.11	54.57	3.29	11.9
Zinc concentrate	9.95	1.21	49.17	11.2
Tailing	2.26	1.01	0.71	15.4

Total extraction for silver, lead, and zinc is 83.7, 87.13, and 72.35 per cent, respectively.

Head and tailings samples are taken by Galigher automatic samplers. Ball consumption is about 1.7 lb. per ton. During 1935 the mill operated 97 per cent of the time, the 3 per cent loss being caused by holidays, power interruption, and repairs to mill equipment. Electric power is obtained from the transmission line of the Southern Sierra Power Company, and an abundance of mine water is available for milling operations. The tailings flow by gravity to a pond about 1½ miles distant from the mill. Dry concentrates are trucked to Tonopah, whence the lead concentrates go by rail to the Selby smelter and the zinc concentrates to Amarillo, Tex.

P. R. Bradley is president of Treadwell Yukon Company, Ltd. To him thanks are due for permission to publish the foregoing article. W. H. Blackburn is manager of the property, with headquarters at Tybo, Nev.

Mine Pumps And Their Selection

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For Unwatering and for Sinking and Other Purposes Where the Installation Is Likely To Be Moved

Lamar Weaver
Assistant Mine Superintendent
Ducktown, Tenn.

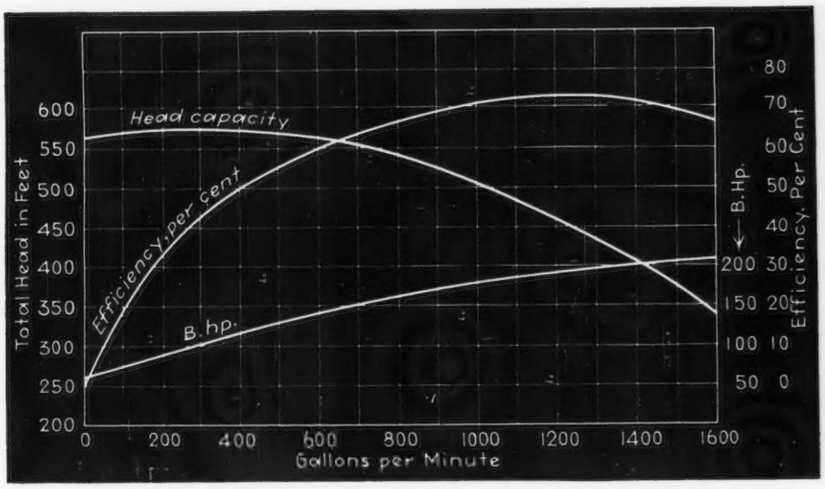


Fig. 1—CHARACTERISTIC CURVES of a 5x17-in. two-stage vertical pump. Note the high efficiency for 1,000-g.p.m. capacity and 500-ft. total head

OCCASION frequently arises for reopening mine workings which have been accidentally or purposely flooded. Such work necessitates the use of equipment which will not only handle the water made under normal conditions but, in addition, will empty the workings in a scheduled time. When water stands long in mine workings it usually becomes acidulous, so that care must be used in selecting the equipment that is to handle it. Equipment in use for such unwatering includes pumps, air lifts, and siphons.

The capacity of the dewatering equipment is determined by two major factors: the work to be done and the time available in which to do it. The quantity of water is computed from data obtained from maps or other records of the mine openings covered by the water. To the volume of water in the openings is added the flow of water into the mine during the unwatering period, to obtain the total. The total quantity of water divided by the days available is the amount of water that must be moved each day. Make ample allowances for pumping delays and then divide the gallons of water to be pumped daily by the minutes the pump runs. The quotient is the desired pumping capacity of the equipment.

In purchasing equipment, when asking a manufacturer for proposals and prices, the following general information should be given: (1) Character of water to be pumped. (2) Size of shaft opening. (3) Capacity of pump in gallons per minute. (4) Total head on pump, giving the maximum and minimum with the average head when available. (5) Power available. If an electric motor is wanted, state the voltage and the kind of current, whether alternating or direct. If alternating, give the number of cycles and phases.

As an example, consider a mine with a total amount of water of 53,000,000 gal., a flow of 40,000 gal. per day (surface drainage), a minimum lift of 100 ft. and a maximum lift of 500 ft., and a shaft with two 5x5-ft. compartments, the shaft being open but in need of repair. The water is slightly acid. The volume of water is distributed as follows: Average head of 135 ft., 15,000,000 gal. (total); 260 ft., 16,000,000; 390 ft., 14,000,000; and 500 ft., 8,000,000. The time allowed for dewatering is two months or less. Equipment is to be selected. The calculations are as follows: 53,000,000 plus (40,000) 60 equals 55,400,000 divided by (60 days x 24 hours x 60 min.) equals 641.2 g.p.m. pump duty for 24-hour service. Assume 36 per cent of the total time as ample for changing pipe, removing timber, and other construction. Then 641 divided by 64 per cent gives 1,002 g.p.m. to be handled by the pump.

A two-stage centrifugal electric vertical pump designed for best efficiencies against the heads of 300 to 500 ft. best fits these requirements of head and volume, if it happens that electric energy is available.

The equipment selected is: A 5-in. two-stage vertical sinker pump complete with supporting frame, motor head, suction and discharge elbows, suction foot valves, flanged check and gate valves on the discharge side, and flexible coupling direct-connected to a 200-hp., 1,750-r.p.m., 2,300-volt, 60-cycle, 3-phase vertical, solid-shaft, squirrel-cage induction motor complete with a hand compensator-type starter. The pump is to be constructed equipped with bronze runners, wear rings, shaft sleeves, and cases.

Fig. 1 shows the characteristic curves. Note that the efficiencies at heads between 400 and 500 ft. run above 70 per cent. With a capacity of 1,000 g.p.m. against a total head of 500 ft., an efficiency of 71 per cent is obtained. This equipment is quoted at $4,050 f.o.b. factory, the shipping weight being

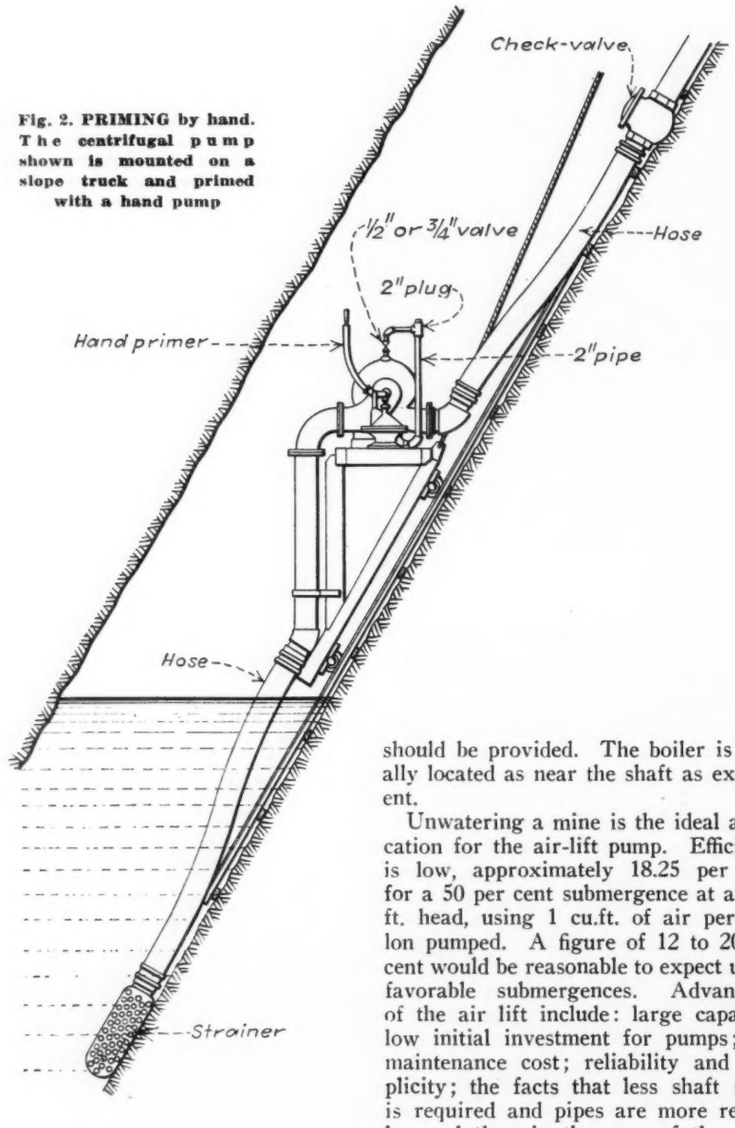


Fig. 2. PRIMING by hand. The centrifugal pump shown is mounted on a slope truck and primed with a hand pump

7,800 lb. A similar unit of 2,000-g.p.m. capacity at 500-ft. head gives a rating of 75 per cent efficiency and is quoted at $5,669 (This and other prices are for 1932).

Where electric power is available the centrifugal pump has no competitor for either vertical or incline shafts, especially if the quantity of water is above 50,000,000 gal. and the equipment must be purchased.

Where high lifts are required in unwatering, it is advisable to lift in stages by using stationary pumps on convenient levels where old sumps are available or there is a suitable place for a dam. Time can be saved by using a rubber hose on the discharge pipe to increase the pump range.

Where an abandoned property without available electric power is to be unwatered for prospecting or valuation purposes, a steam plant and a steam-driven vertical plunger sinker will generally be used, the exhaust steam being piped back to surface. Ample boiler capacity should be provided. The boiler is usually located as near the shaft as expedient.

Unwatering a mine is the ideal application for the air-lift pump. Efficiency is low, approximately 18.25 per cent for a 50 per cent submergence at a 200-ft. head, using 1 cu.ft. of air per gallon pumped. A figure of 12 to 20 per cent would be reasonable to expect under favorable submergences. Advantages of the air lift include: large capacity; low initial investment for pumps; low maintenance cost; reliability and simplicity; the facts that less shaft space is required and pipes are more readily lowered than in the case of the usual pump with suction and discharge pipe; and flexibility, inasmuch as any number of pumps may be used. The workmen can pursue their shaft-repair work and other duties with less fear of interruption.

The air lift works on the following principle: Admitting a volume of compressed air into a column of water reduces the specific gravity of the water. The energy operating the air lift is that energy in a volume of compressed air released in a fluid column in the form of bubbles at or near the end of the submerged portion of the discharge pipe; and the driving force causing the pump to operate continuously is the unbalanced hydraulic pressure in the discharge pipe resulting from a mixed column of water and air bubbles of less specific gravity than the outside opposed column of unmodified water. Submergence is the distance the pump or foot piece is submerged below the pumping level. Submergence is expressed in percentage of the total length of pipe. Example: total pipe length of 400 ft. with lift of 150 ft. is $\frac{(400 - 150)\ 100}{400} = 62.5$ per cent.

An air lift can be made by using some type of strainer on the bottom of a discharge pipe and inserting a smaller air line down this pipe. This gives advantage in unwatering where difficulty is encountered in putting pipe down through fallen timbers and débris. The pipe can be sharpened to a point and perforated above this to afford an entrance for water, the air pipe then being lowered from surface to the desired submergence.

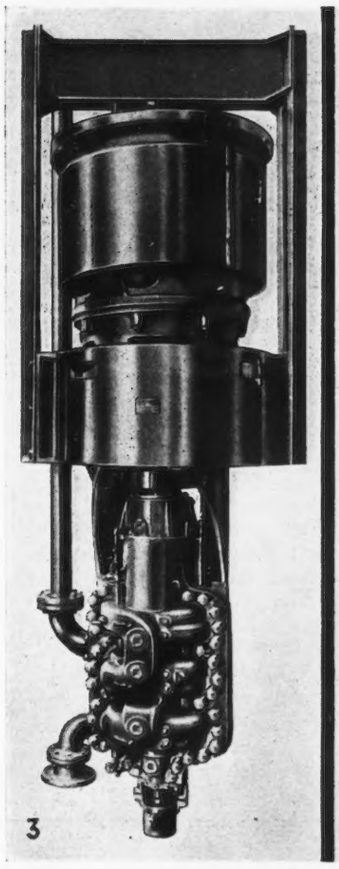
Excellent results have been obtained by use of air lifts in conjunction with station pumps, permitting good submergence and large volumes and raising the water to a more efficient pump, as suggested for stage lifting with a centrifugal sinker on high heads. This booster pump will usually prove to be a suitable unit for a station pump subsequently.

In unwatering work, an experienced foreman will start by installing a good collar set for carrying the weight to be imposed. If the mine is to be opened for operation, the shaft timbers should be repaired or replaced as the water recedes. A small hoist or a hand crab-winch for handling the pump will be found advantageous. When a direct-acting (steam) pump is used, it is well to have a line lubricator on the feed line from surface. As the water is lowered, careful inspection should be made to detect any trapped bodies of water that are held back by partly stopped openings. Neither motor or pump should be overloaded.

Table I gives a comparison of the cost of the three methods of unwatering. Electric power is assumed to be available at $0.01 per kilowatt-hour and ample air-compressor capacity for mine operation, the unit referred to developing 290 cu.ft. of free air per kilowatt-hour at 90 lb. effective pressure on the feed line.

Sinking Pumps—The choice of a sinking pump depends on the size of the shaft opening, the quantity of flow, characteristics of the water, depth to be reached, available power, and considerations for other operations (as when sinking under a pentice of an operating shaft).

Small quantities of water are usually handled by horizontal piston pumps of the Cameron pattern. The motive power is either steam or compressed air, preferably the latter. This pump is built in both vertical and horizontal and outside-packed and inside-packed styles, with valves easily accessible and free from external breakable parts, so that it is able to stand hard service. The pump selected must be dependable when handling gritty water and when poorly primed for a short duration of time, as in those cases when the suction becomes uncovered.



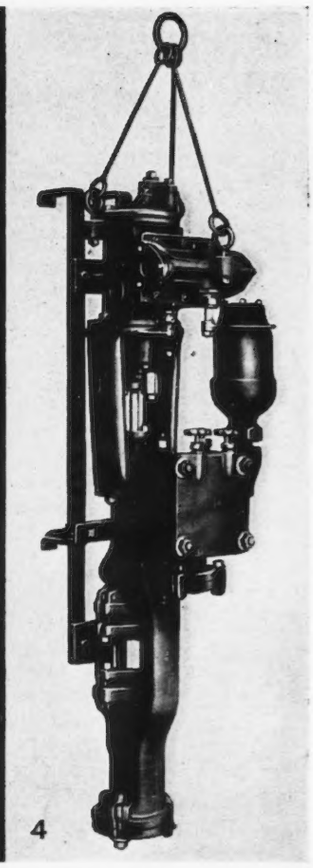


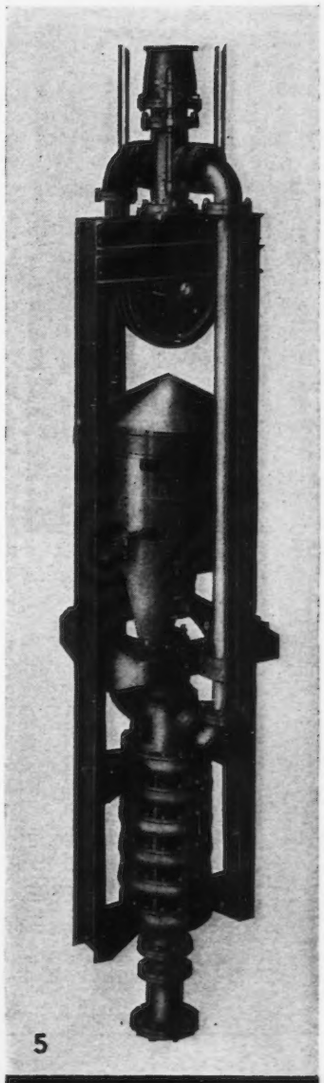
Fig 3. VERTICAL sinker, of the centrifugal type and six-stage, made by Byron Jackson Company for mine unwatering

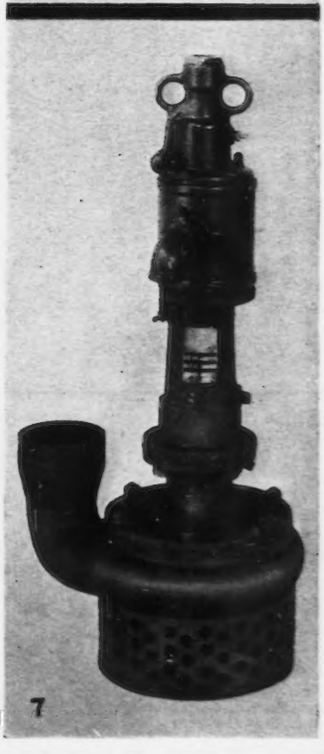
Fig. 4. A PLUNGER type (Cameron) of vertical sinking pump

Fig. 5. TURBINE centrifugal pump for vertical shaft sinking. Made by American Well Works for a lift of 400 ft. and 750-g.p.m. capacity

Fig. 6. SINGLE cylinder piston pump, made by Ingersoll-Rand. The piston type is preferred for field pumping in prospecting work because it is more compact, easily guarded, and is low in first cost

Fig. 7. THIS PNEUMATIC "sponge" pump is submerged for priming and will work to within about 3 in. of the bottom. It is sturdily built for service





The vertical pump is a necessity where the flow of water is large and the shaft is too small for the horizontal type. Also, the vertical pump can be swung from the timber on one end of the shaft and thus conserve space.

The horizontal pump is preferred by some operators because the capacity is greater for the same weight, and for the reason that it is more useful for general mine service after sinking is stopped, more economical in first cost, and more accessible for repair.

It is cheaper to keep the water from going to the shaft bottom than to remove it by any means. The cost of sinking labor increases about $10 to $12 per foot for each 100 g.p.m. of flow, depending to some extent upon the handling equipment. Seepage water, or water from crevice or underground channels, is usually sealed out of the shaft or drained to a storage sump as soon as possible after sinking past the water area. Water is collected from the shaft walls by a concrete collar or launder for drainage to an opening made in the wall for a pump sump and station. A suitable pump is then installed for this duty. Water in the bottom of the shaft is reduced to a minimum and progress in sinking is resumed. The desirable elevation for this station would be that elevation of a future mine level.

When it is necessary to use steam, ample boiler capacity should be provided, as sinking pumps are very inefficient, requiring from 200 to 250 lb. of steam per actual horsepower-hour. Example: A flow of water of 300 g.p.m. for a lift of 400 ft. will require for pumping alone $\frac{(300 \times 8.33 \times 400)}{33{,}000} \frac{200}{30}$ = 202 boiler horsepower. At least 50 per cent extra capacity should be provided to handle the water, in one or more units as the choice may be. If more than one unit is necessary, separate discharge lines should be provided. All pipe lines should have swinging joints at the pump to relieve excess vibration. Main steam and exhaust lines should be kept in one end of the shaft to assist ventilation by creating air currents.

The centrifugal pump has been adapted to meet the sinking problem in the vertical, open-impellor type equipped with an automatic priming attachment and designed to operate under wide variations in head without overloading the motor or developing a serious loss in efficiency. Fig. 5 illustrates a vertical sinking pump. A pump made for a vertical lift of 400 ft. and a capacity of 750 g.p.m., it has over-all dimensions of 32 in. by 35½ in. by 12 ft. 2 in. long for the frame, and an efficiency of 55 per cent. These units are built to handle capacities up to 400 ft. As with other vertical sinkers, the pump is suspended by a cable. It is so designed that it will not overload the motor under variable heads and is equipped with non-clogging open-type impellers. This makes unnecessary the use of wearing rings, which are the parts most effected by wear from pumping gritty water. The cost of the unit is more than that of the horizontal type, but not excessive when considered as a unit.

Table I—Comparison of Respective Costs of Unwatering by Three Different Methods

Continuous Work for 700 g.p.m.	Reciprocating Pump, Compressed Air	Air Lift Working With Centrifugal Pump	Electric Centrifugal Sinking Pump	Values Given, Usable Equipment
Days pumping	60	60	60	.....
Unit efficiency	20%	36%	60%	.....
Energy required, million ft. lb.	1,252,500	695,833	417,500	.....
Kilowatt-hours	471,894	262,162	157,297	.....
Power cost at 1c.	$4,718.94	$2,621.62	$1,572.97	.....
Operating labor	2,420.00	2,220.00	2,220.00	.....
Purchase cost, motor, starter, and pump	3,550.00	2,863.00	4,050.00	$2,863.00
Pipe cost	725.00	1,075.00	625.00	625.00
Power cables	.....	410.00	450.00	410.00
Installation cost	450.00	430.00	300.00	.....
Total cost	$11,863.94	$9,619.62	$9,217.97	$3,898.00
Salvage value with which to operate	625.00	3,898.00	3,898.00	.....
Net cost	$11,238.94	$5,721.62	$5,318.97	.....

Table II—Data for Vertical Plunger Sinking Pump (Cameron Type VPS)

Diameters in Inches						Prices—Water Cylinder			
Water Cylinder	Steam Cylinder	Stroke, Inches	G.P.M.	Shaft Space, Inches	Weight, in Pounds	Iron Steel Piston	Brass Rods Lining and Pistons	Air Pressure, Pounds	Free Air Consumption
3	6	7	27	20½ x 19	750	$290	$305	66	89
4	8	12	83	25 x 25	1,500	450	475	94	355
5	10	13	130	31 x 30	2,300	620	670	94	570
5	12	13	130	32 x 31	2,500	720	770	65	605
7	12	13	206	34 x 34	3,200	820	920	128	865
7	14	13	206	37 x 37	3,800	920	1,020	94	900
9	18	16	247	45 x 39	5,900	1,350	1,510	94	1,080
10½	16	16	427	52 x 62	6,000	1,600	1,775	162	1,750
10½	18	16	427	52 x 62	6,200	1,700	1,875	128	1,795

Sizes of Type VPS range from 3 in. to size 12-B. Stroke ranges from 7 in. to 16 in. Cylinder diameters range from 6 in. to 18 in. for steam; from 4 in. to 10½ in. for water. This type is applicable for 150-lb. steam pressure, and cylinders are good for 250-lb. maximum water pressure.

For smaller quantities of water the pump manufacturers offer a vertical pump directly connected to a compressed-air motor designed for pumping about 50 g.p.m. against a head of 120 ft. and increasing to 125 g.p.m. against a head of 50 ft. The unit complete weighs only about 75 lb., and is sturdily constructed, with motor and ball bearings well protected from water. It can be furnished in special metals to resist erosion. The runners are of the two-ported or open non-clogging type. The pump is submerged for priming and will pump to within about 3 in. of the bottom. This handy little pump has met with universal approval and is quoted on the market at prices from $150 to $200. For heads above the lift of this pump it is the practice to use a second or booster pump. The water is pumped from the bottom of the shaft with the air centrifugal pump to a tank located in the shaft above and far enough away to avoid damage from blasting. A booster pump lifts the water from the tank to the desired level.

Special examples where greater volumes of water are to be handled may be found in the *Transactions* of the Federated Institute of Mining Engineers, Volume III, page 513, in which W. H. Chambers describes the handling of 6,600 g.p.m. in the sinking of two shafts in Cornishboro, Yorkshire. Another case is that of the Harden Colliery, in southeast Durhamshire, described by J. J. Prest in the *Proceedings* of the Institute of Civil Engineers, Vol. CLXXII, Part 3. Still another reference is "Practical Shaft Sinking," by F. Donaldson.

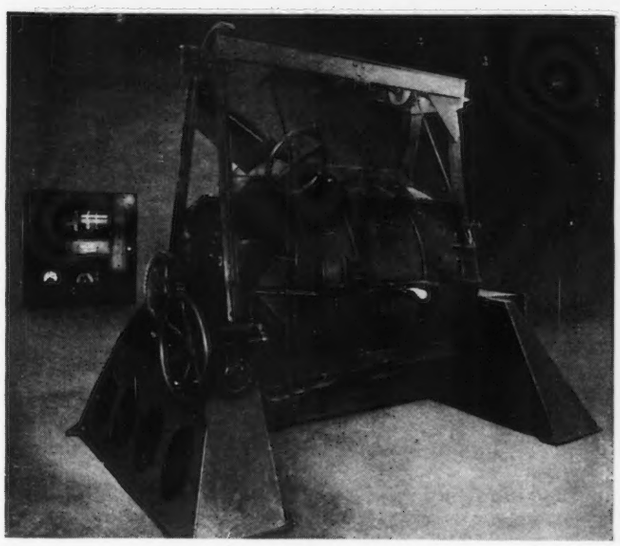
Pumps for Prospecting—Prospecting pumps are portable or semi-portable, the capacity ranging from 5 to 100 g.p.m. for heads up to 200 ft. For diamond-drill or boiler feed-water supply the pressure should be uniform.

Piston or plunger pumps are generally employed for field pumping, the former type being preferred because it is more compact, easily guarded, and low in first cost. A duplex piston pump is recommended. This pump is suitable for boiler feed, diamond-drill water circulation, water supply, and drainage of pits or mine openings within its capacity.

Field pumps in general should be capable of handling some gritty water and be able to pump air and water alternately and maintain a flow of water with the suction pipe partly submerged. They should also be rugged, simple, and easily primed.

The price of a suitable steam-driven, packed-piston duplex pump for 200-ft. pressure, fitted with bronze-lined cylinders and bronze rods and pistons, varies from $66 for a unit of 3.3-g.p.m. capacity to $200 for one of 59-g.p.m. size. This pump is also available for motor drive with belt, Tex-rope, or gear reduction. (1932 prices.)

(*To be continued*)



THIS ELECTRIC REVERBERATORY FURNACE may be used for melting gold and other metals. The lower half of the cylinder contains the hearth and the upper part the firing chamber. The unit is fabricated by electric welding and is sectionalized

THE FIRING CHAMBER contains silicon carbide heating elements called "Globars," which are held in place under heavy spring tension from the outside of the furnace. The heat control is actuated by the inserted platinum-rhodium thermocouple

Speed in Gold Melting

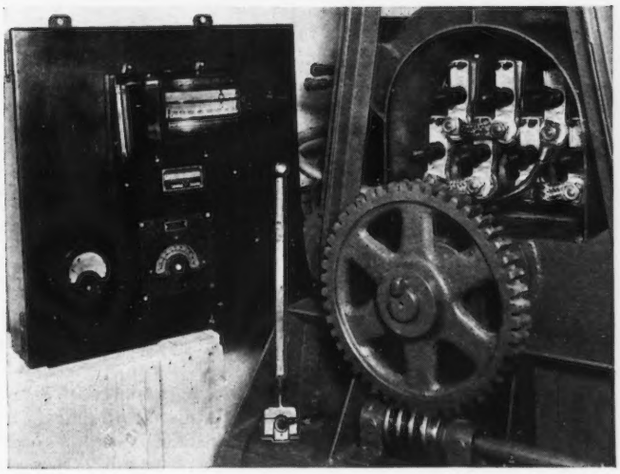
Electric reverberatory furnace at Bulolo has automatic controls and large capacity

M. W. MacAfee
Metallurgical Engineer
Pan American Engineering Corporation, Ltd.
Berkeley, Calif.

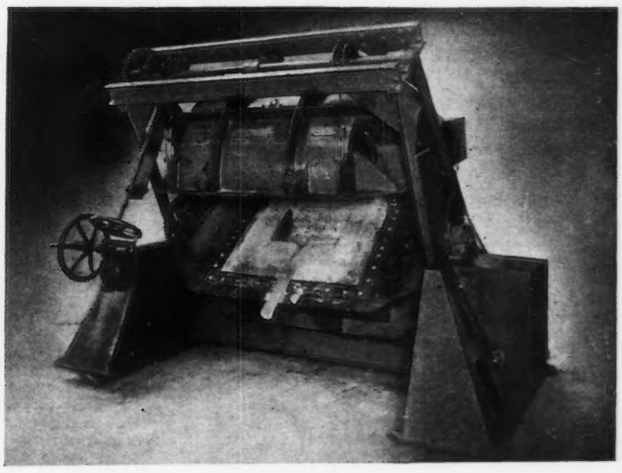
ON THE GOLD DREDGES of the Bulolo Gold Dredging Company, which is operating in the Bulolo Valley section of New Guinea, the clean-up is made weekly, and the gold produced is melted and cast into bars for transportation. With four 10½-cu.ft. dredges in operation, the output at present is approximately 4,000 oz. of bullion per week, or about 275 lb. avoirdupois. Upon completion of two additional units now under construction, the output is expected to be increased to about 6,000 oz. of bullion per week, or approximately 410 lb. avoirdupois.

Formerly the equipment used for melting the clean-up consisted of small gasoline or oil-fired crucible furnaces, in which it was necessary to melt gold about four days a week. The cost of fuel, labor, and crucible replacement was high, due to the handling of so many small batches of gold. In view of the abundance of cheap electric power, the use of an electric furnace for bullion melting offered attractive possibilities. With the cooperation and technical assistance of Messrs. Frank Short and F. W. Griffin, consulting engineers for Bulolo, the Pan American Engineering Corporation, Ltd., of Berkeley, Calif., designed and constructed a tilting electric reverberatory furnace with full automatic heat control. This furnace is capable of melting rapidly in one charge, the weekly

SIDE CONNECTIONS OF THE "GLOBARS," the pyrometer controller, and the removed thermocouple are shown in the photograph below. Turning the gear wheel moves the lower section of the furnace in position for pouring



POURING POSITION showing the size of the furnace hearth, which has a volume capacity of one cubic foot and will conveniently hold 15,000 oz. of melted gold. The upper section is moved by turning the upper wheel



output of gold, using one furnace man and a helper for the operation. It is known as the Type T-1400 C.

The furnace consists essentially of a cylindrical shell supported horizontally and divided into two parts, the lower half containing the melting hearth and the upper half the firing chamber. Melting is accomplished by strictly reverberatory heating on the surface of the charge in the hearth, the heat being supplied by carborundum resistance bars known as "Globars." These units are exactly what their name implies — resistance-heating elements which glow white hot on the passage of suitable current, either alternating or direct. Moreover, they can stand a very high temperature, and owing to their comparatively large diameter, have a high surface radiation heat output. This radiation output is about 125 watts per square inch of surface area of the Globars and is due to two principal factors—namely (1), the high resistivity of silicon carbide with a consequently large cross-section for a given resistance, and thus a large surface radiation area; and (2), also to exceptionally high emissivity because of the rough, crystalline surface of the element which greatly increases the apparent radiating area.

The Globars proper are electrically contacted by water-cooled tubes extending through the insulation at the ends of the firing chamber and holding the heat elements in place under heavy spring tension supplied from the outside of the furnace. The Globar thus floats in its firing chamber and is free to expand or contract, with a good electrical contact at all times.

Furnace shell, trunnion supports, and lid-lifting crane are of rigid steel plate and angle construction, entirely fabricated by electric-arc welding, the only exception being that the entire furnace is sectionalized for knock-down transportation. The sections are joined with bolts in the field. The structural materials used were of the lightest possible weight, featuring ribbed construction with welded stiffening fins throughout. The insulation is so designed that the shell of the furnace will never exceed 90 deg. C when full thermal equilibrium has been reached. It consists of 4½ in. of light-weight, high-temperature insulating refractory brick known as "Infrax," followed by 9 in. of packed monolithic insulation composed of calcined diatomaceous material known as "Sil-O-Cel" C-3, bonded together with ordinary cement. The preparation of this monolithic insulation is interesting, because of the fact that the cement itself is kept from entering the pores of the Sil-O-Cel and merely bonds the Sil-O-Cel fragments together, allowing them to retain their full insulating properties. This is accomplished by saturating the Sil-O-Cel with water first and then working dry cement into the mixture. The capillary pores of the Sil-O-Cel cannot absorb the particles of cement. The resulting material, when all water has been expelled by drying, is light in weight and possesses high mechanical strength and high insulating properties, together with a low coefficient of expansion within its temperature range.

The hearth consists of a silicon carbide refractory material known as "Carbofrax" No. 3 cement. This material is dampened with water and rammed into place under a form. The actual melting hearth or crucible is 2 in. thick. The advantage of this hearth is readily apparent, since it is more refractory and resistant to corrosion than a graphite crucible, and in addition may be patched up from time to time by merely tamping and troweling a new layer of the same material on the corroded part of the hearth. This patch, when fired, frits together and becomes monolithic with the original material, thus obviating frequent complete replacement of the hearth.

Pyrometer Control Gives Automatic Operation

Operation of the furnace is automatic, and the control equipment is actuated by a suitably protected platinum-rhodium thermocouple inserted into the firing chamber. A pyrometer operating through a small relay in the control cabinet automatically shuts the current off when the temperature set-off on the pyrometer is reached, and turns it on again when the temperature falls below this setting. An interval timer known as a "Reduced Input Controller," operating once every 60 seconds, controls the actual time the electric current flows through the heating elements. This controller is graduated from zero to 100 per cent, and, when set, for instance, at 20 per cent, turns the current on to the heating elements once each minute and allows it to remain on for 12 seconds. It is thus off for 48 seconds and on for 12 seconds of each ensuing minute, the net result being that by simple adjustment of this small dial the rate of heating may be controlled and the permanent change in the resistance of the Globars, with age, compensated for, giving a longer life under less severe operating conditions than tapped transformers or variable voltage devices would allow.

The furnace hearth has a volume capacity of 1 cu. ft. and will hold the following weights of melted material when full: gold, 15,000 troy ounces, or approximately 1,000 avoirdupois pounds; silver, 8,000 troy ounces, or about 550 avoirdupois pounds. If the material to be melted is bulky or spongy, such as retort gold or cyanide precipitate, the hearth must be charged consecutively after each sponge or precipitate charge has been melted down. Under normal conditions the actual electric current consumption per hour is about 45 kw. The load is, of course, much higher than this figure, but is on only a small percentage of the time. Suitable atmosphere seals are provided so that any desired condition may be maintained in the furnace hearth during operation. Air may be completely excluded to maintain reducing conditions, or air may be blown in for refining or elimination of gases formed by fusion of the material or fluxes.

In operating the furnace, normally all that is required is to close the lid, set the pyrometer controller for, say, 1,200 deg. C., snap the small toggle switch on the controller, and allow the furnace to heat up to this temperature. The lid is then raised by means of an easily operated hand wheel, the material to be melted charged into the hearth, the lid closed, and the pyrometer set up to about 1,400 deg. C. No further attention is necessary until the pyrometer has reached 1,400 deg. C., when the current is shut off. This may take from 30 minutes to an hour, depending on the quantity of material charged into the hearth. Next, the lid is opened about 12 in., suitable molds are moved under the pouring spout of the furnace, and the charge is poured.

During the heating, charging, and pouring periods there is little or no heat radiation or discomfort around the furnace. The furnace shell temperature is so low that it will scarcely feel hot to the hand. As the furnace is silent in operation as well as flame-free and dustless, its installation and operation can be effected in a clean, dustless melting room, with consequent less dirt, confusion, and liability of fire and theft. Actual B.t.u. requirements converted into kilowatt-hours for melting 400 lb. of gold in this furnace are as follows: Water-cooled terminal loss, 20 kw.-hr.; heat loss through insulation, 20 kw.-hr.; total heat required to melt the gold and raise its temperature to 1,200 deg. C., 30 kw.-hr.; or a total of 70 kw.-hr., to which must be added heat loss in opening the furnace for charging and miscellaneous safety factor calculations.

About 140 kw.-hr. will be required for this type of melt. On the Mother Lode in California, the comparison between the cost of electric melting and the conventional oil-fired melting in crucible furnaces, figuring diesel oil at 5c. per gallon and electricity at 7 mills per kilowatt-hour, is approximately 3 to 1. In other words, if $3 worth of oil at 5c. per gallon is required to make the melt, it would cost only $1 at 7 mills per kilowatt-hour to make the same melt in the properly designed electric furnace. At Bulolo, where the cost of gasoline and oil, due to high transportation costs, is 80c. and 60c. per gallon, respectively, and the cost of electricity, due to available hydro-electric power installations on the property, will not exceed 5 mills, this differential becomes very great indeed; of the order

(*Continued on page 629*)

NEWS
OF THE INDUSTRY

Threatened Walkout of Miners in Mexico Fails to Materialize

Federal Labor Board and Officials of Oil and Mining Companies Seek to Settle Strike Actions

✦ Late in November the mining industry throughout Mexico became a target of the Miners Syndicate, which demanded a general walkout as a protest because of the continued strike at the Moreles smelter of the American Smelting & Refining Company in San Luis Potosi. This action was considered to be in sympathy with the strike threatened in the oil industry. On Nov. 30 the oil strike was postponed as company officials, members of the Federal Labor Board, and syndicate petroleum workers agreed to outline conferences for settlement of difficulties. This action nullified the threatened general strike of miners. Meanwhile government officials and representatives of the American Smelting & Refining Company continue to seek a settlement of the smelter strike.

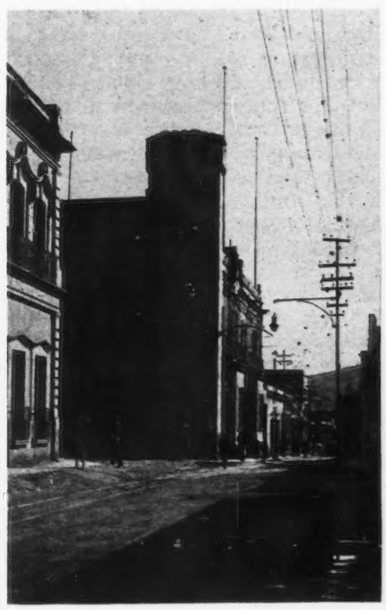
✦ Stimulation for the mining industry is made evident by the railroads which the Federal Government is building from Ixcaquixtla, Puebla, Mexican Southern Railway station, to Chacahua Bay, a Oaxaca West Coast port; Santa Catarina, Michoacan, on the National Railways, to Zihuatanejo, a Pacific port in Guerrero; and Fuentes Brontantes to Punta Penasco, Lower California, with a later extension to Santa Ana, Sonora, on the Southern Pacific Railroad. These railways are to be completed between 1938 to 1940. They will not only afford existing mines additional transportation facilities but will open up several mining regions. The Ixcaquixtla-Chacahua Bay railroad traverses a region where experts say exists a large iron deposit estimated to contain 10,000,000 tons of metal.

✦ Eighty tons of ore a week are being shipped by Cia. Minera la Corteza from its property in the Peregrina zone, Guanajuato, to the Guadalupe customs mill. Dr. A. Wandke and Frederick Heim, both of Guanajuato City, are president and secretary, respectively, of the company. Plans are being made to construct a mill at the property.

✦ A Straub ball mill of 35-ton capacity and a concentration table are being installed by Santa Felicitas Gold Mining at the Santa Felicitas mine, which it recently acquired near Caborca, Sonora. The company is managed by A. M. Conrad.

✦ Cia. Minera de Promontorios, S. A., is arranging developments at the old La Colorado workings, Sonora, between Hermosillo and Guaymas, on the Southern Pacific Railway of Mexico. Machinery and equipment are being installed.

✦ Engineer Vicente Cortes Herrera, Subsecretary of Communications and Public Works, announces that Henry Horton, Los Angeles mining man, is preparing to revive the San Antonio and El Triunfo copper properties in Lower California because of the Mexican Government's economic and social rehabilitation program for lower California and Quintana Roo territories. Mr. Horton heads the Cia. Minera de San Antonio and Cia. Triunfo del Peninsolar.



A STREET IN PACHUCA, famous silver mining district of Mexico

✦ The resolutions adopted by the convention of about 1,000 small mining operators held in Mexico City last September may be of a far-reaching consequence, judging from the following issued statements:

1. **Assistance from the Government.**—The small mining operators uphold the interests of the national mining industry, for which a fair and well-guided assistance from the government is hereby most earnestly requested.

2. **The Mine Operators and the Smelters.**—The small and large mine operators and the large smelters and ore-treating custom plants are all part of Mexico's mining industry, and measures, whatever their nature, adopted by the government, the consequence of which might be to affect the large smelting and ore treating enterprises controlling the ore-market in Mexico, shall also impair the small mining operators.

3. **The Sexennial Plan.**—The convention of small mining operators acting within the laws of a revolutionary government that bases its existence on the principles proclaimed by the Mexican Constitution, in the development of all mining activities shall always maintain the application of the Sexennial Plan of public administration.

4. **The Financial Mining Organization.**—The small mining operators are ready to cooperate in the financial organization of a Mexican Mine Financing Bank, to operate exclusively within a technical and economical sphere, thus removing any political or detrimental influence from its organization and management in order to be of benefit for our mining industry.

5. **Mining Roads and Trails.**—Every mining state shall invest the financial resources granted them by the laws in the construction of roads. The Federal Government is to accept private cooperation in the construction of railroads and the Federal Government should adopt stimulating measures like subsidies or otherwise for the establishment of airway routes to remote mining regions.

6. **The Cooperation of Mine Operators.**—Mining operators of the Republic are willing to cooperate with the Federal Government in the study of a mining legislation to serve as a foundation for the economical rehabilitation of the mining industry.

7. **Assistance to Prospectors.**—Advocate real protective measures for "gambuzinos" or "buscones" (prospectors).

(*Continued on page 629*)

California

Central Eureka Mines Plan Development Program

LOWER OREBODIES in Eureka mine will be determined—War Department appropriates funds for debris dam investigations

✦ Central Eureka Mining Company, operating the Central Eureka and Old Eureka mines, at Sutter Creek, plans to start a comprehensive development program involving an expenditure of from $70,000 to $90,000, as recommended by Ira B. Joralemon, consulting engineer, San Francisco. The north drift from the main 3,000-ft. level is to be extended about 1,250 ft. to the projected position of the north orebody to facilitate development of orebodies from the 2,500 to the 3,000-ft. level in the Old Eureka mine. This is to be followed by sinking a winze below the 2,500 level and raising to connect with this winze between the 3,000 and 2,500 levels. Funds necessary for carrying out the proposed campaign are to be obtained through a 5c. assessment on outstanding stock. C. C. Prior is president of the company.

✦ Good progress is being made by Nevada City Gold Mines, Inc., in rehabilitating the Live Yankee property, near Nevada City, where considerable new equipment, including a headframe over the 400-ft. Fortuna shaft and also pumps, has been installed recently. Electric power is obtained from a branch line. H. P. Davis is in charge of operations.

✦ Enlarged to a daily capacity of 100 tons, the mill at the Longfellow mine, at Big Oak Flat, has started operations. At present the plant is treating material from old dumps said to contain about 100,000 tons of commercial ore, which is removed by a dragline and deposited in a large loading bin prior to being trammed in 1-ton cars to the mill. In addition there are available for re-treatment 30,000 tons of mill tailings. Development underground is proceeding satisfactorily. The property is owned by California Gold Lode Mines, Inc., J. Milton Ward, president, and Longfellow Milling Company is handling the dumps and tailings.

✦ Early construction of a 100-ton milling plant is planned by Vera Mines Corporation, controlled by Santa Barbara interests, at the Uncle Sam mine, near Kennett. The mine is opened by a 2,900-ft. tunnel, and a large tonnage of milling ore is said to be available. The company is also operating the neighboring Fairview mine. Operations are directed by A. A. Wren.

✦ According to a report from Sonora, work has been started on a 150-ton flotation cyanide mill at the Confidence mine, 12 miles northeast of Sonora, by the Confidence Gold Mining Company. The flowsheet of the flotation department follows closely that of the newer plants in California: namely, crushing in a Traylor gyratory crusher, fine grinding in a ball mill operating in closed circuit with a Dorr classifier, and treatment of the pulp in four 44-in. Fagergren cells. The cyanide plant is of the countercurrent type. C. T. Eastman is manager, and Richard Krebs, metallurgist, designed the mill.

✦ Early resumption of hydraulic mining has been brought a step nearer to realization by the appropriation of funds to finance foundation investigations and plans for four debris dams on the Bear and Yuba rivers and north and middle forks of the American River. The War Department has recently made available $100,000 for this purpose, according to word received from Washington, D. C., by the California Debris Commission, and all preliminary work is to be carried on under direction of army engineers who are members of the commission.

✦ With nearly 100 men employed, satisfactory progress is being made in the construction of the new all-steel dredge near the Nye school, in the Folsom placer area, which is to replace the unit sunk some time ago. Built along the lines of Natoma No. 2, the new dredge will dig 68 ft. below water and is estimated to handle about 12,000 cu.yd. a day. R. G. Smith is manager of the dredging department of the Natomas company, with headquarters at Natoma.

✦ Following a successful test run, Idaho Maryland Mines Corporation has placed in operation the new mill at its King Midas mine, at Forbestown. The plant will also treat ores mined in the Gold Bank and other mines owned by the company in the Forbestown district, and concentrates produced are to be treated at the cyanide plant in Grass Valley. About 100 men are employed under the direction of John Ehrhorn, superintendent.

✦ At the Pennsylvania mine, in Browns Valley, operated by Empire Star Mines Company, Ltd., Grass Valley, an elaborate plant construction program is in progress. Apart from several large buildings to house the repair shops and store material, a new steel headframe and two circular bins, each 8 ft. in diameter and 36 ft. high, have been erected over the three-compartment shaft, and excavation for a 50-ton pilot mill has been started. In course of installation are a 100-hp. double-drum hoist and a 1,300-cu.ft. air compressor. A power line is being run from the P. G. and E. company substation to the Sweet Vengeance mine, near by, as a preliminary to early development. George A. Kervin is general manager.

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Colorado

Santiago Shaft Dewatered

SEVERAL new mining operations started in the State

✦ The Santiago Mines Corporation, at Georgetown, has completed dewatering the main shaft of the Santiago mine, and the shaft will now be deepened to the horizon of the Wilcox tunnel. The following mines and mills in Georgetown-Empire-Idaho Springs section are now operating: the Bruce, Alma-Lincoln, Humboldt, Freeland, and Gold Dirt (Gold Dirt Mining & Ore Reduction Corporation, Box 151, Littleton), Conqueror, O'Dell properties, Commonwealth (C. N. Lyons and Associates, Idaho Springs), Griffith, Hall tunnel, Waldorf Gold, Kilpatrick, and Santiago.

✦ The Capital Refining Company, at Boulder, is now treating a small tonnage of custom ore. Maurice Sachs is manager.

✦ Work has been started on the following mines in the State: the Susquehanna (Henry Johnson, 828 East Colfax Ave., Denver), Dauser (Dee Clark, Box 71, Alma); Elizabeth, Glover Tunnel and Marmac Mines at Alma, in Park County; the Connors and Utah Tunnel at Kokomo, in Summit County; the Emma L. and Lame Duck Mines in the Cripple Creek District; the Emerson Mine, at Great Divide, in Moffat County; the Klax mine, at Breckenridge; the Buffalo mine, at Durango; the Edna and Irene mine, at Lay, Moffat County; Blake mine, at Naturita, Montrose County; the Albert Shaft and the Josie May Turquoise mines, at Leadville; and the Trafalgar (W. W. Winburn, 1414 Forest St., Denver), the El Rico Mine, and the R. Warrior Mines, in Chaffee County. The managements of these properties have made provisions to work most of the winter.

✦ Guy Harkness & Associates have leased the C.O.D. property and installed a five-drill electric compressor, a 75-hp. electric hoist, and completed building construction.

✦ Lessees Ward, Brown, and Zimmerman are reported to have made a rich strike between the 20th and 21st levels on the Vindicator. Some ore said to assay $225 per pound is being sacked and shipped to the Golden Cycle mill.

(*Continued from page 627*)

8. The National Mining Congress.—A national Mining Congress, with delegates from every mining state locally organized, shall take place in the City of Mexico during January, to effect action and purposes aiming toward the complete rehabilitation of the national mining industry.

9. The Nationality of Mining Capital.—Investments already made or made in the future for the exploitation of our mineral resources and the development of our mining industry must be based not on the size or the amount of the invested capital but on its quality and tendency. An investment beneficial to our country is an investment by Mexicans or foreigners deriving its legitimate profits from the technical exploitation of any mining enterprise; an injurious investment is one where Mexican or foreign interests strive to obtain its profits by the exploitation of the laboring class. Nationality of an investment is a relative one. Mexican capital having been accumulated in Mexico by our countrymen, is, however, a foreign capital because it has been sent abroad or transferred to other countries. Capital coming from another nation may be, despite this fact, a Mexican capital because it has been invested in this country with entire submission to the Mexican legislation and is thus far producing an economical movement beneficial to our collectivity. In short, every capital invested in Mexico complying with our laws and regulations, yielding an economical benefit within our country and the profits of which augment the assets of our national economy, shall be a Mexican capital, irrespective of the nationality of the investors, and, as such, this Mexican capital shall be the object of the respect of our countrymen and shall enjoy the protection of our government.

The permanent Executive Committee elected was: President, Genaro P. Garcia; secretary, Alberto Terrones Benitez; treasurer, Miguel Espinoza y Elenes. Members: Constantino Perez Duarte, Jose A. Garcia, Joaquin Santaella, and Santiago Gonzalez Cordero. The Committee's address is Avenida Madero 26-100 Mexico City.

✦ Cia. Metalurgica Mexicana is exerting court action against rejection by the Federal Board of Conciliation and Arbitration of its request for permission to close the company's San Pedro unit, at San Luis Potosi, until settlement of the strike which closed the Asarco's smelter at Morales. The board held that the mining company must continue working, whereas the company asserts it must suspend operations because the smelter strike makes no market for its ore.

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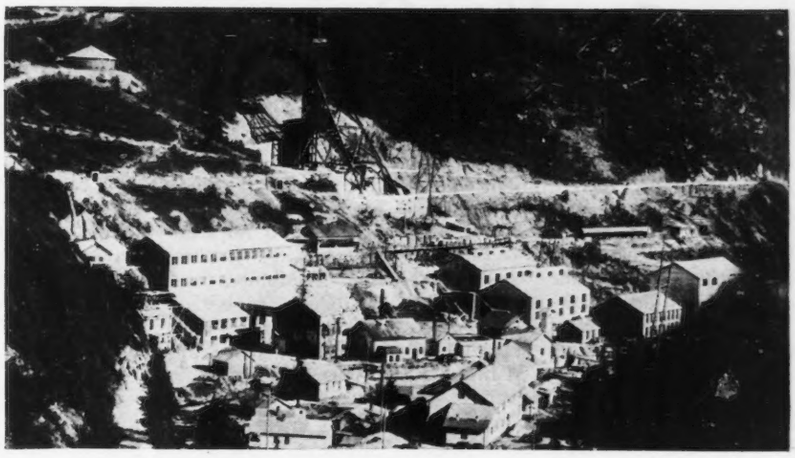
Speed in Gold Smelting

(*Continued from page 626*)

of magnitude of $64 per melt with gasoline, or $48 per melt with oil, compared to $1 per melt with electric power. These figures are for general comparison and do not take into account base bullion, refining in the furnace, heat required by fluxes, heat loss during slag skimming, and such other similar items which are specific with each type of application. However, the ratio of comparison of cost will be fairly close. The range of application of this furnace is not limited to gold, silver, or cyanide precipitate melting, but may be extended to brass or copper melting with no modification on the hearth refractories or electrical equipment.



THE SUNSHINE MINE, America's largest silver producer, expects to set a new record in silver production during 1936. During the first nine months it has shipped to the mint 6,138,918 oz. of silver, compared to a total of 5,878,135 oz. during all of 1935

Idaho

Higher Wages for Coeur d'Alene Miners

SILVER PRODUCTION from Sunshine at new record

✦ Effective Nov. 16 wage increases of 50c. per shift went into effect at the Bunker Hill & Sullivan, Federal Mining & Smelting Company, Hecla Mining Company, and Sunshine Mining Company. Notices stated that "owing to the advance in the metal-market price of lead, all employees will receive a wage bonus increase of 50c. per shift. It is hoped that metal prices will justify a continuation of this increase." By this action wages in the Coeur d'Alenes were increased by about $1,500 daily or close to $40,000 per month, approximately 3,000 men being affected. Under the new schedule, timbermen will receive $6.25; miners, $5.75; shovelers, $5.25; common labor $5.00.

✦ Production for the third quarter at the Sunshine mine was 2,582,205 oz. of silver. Output has been increased to more than 1,000,000 oz. monthly, and when the new four-compartment shaft is completed to the 2,300 level during the first quarter, production will be further increased. The company recently declared a dividend of 75c. and announced that the Christmas bonus to employees will be increased 50 per cent above that of last year.

✦ Operations are progressing rapidly at the Whitedelf mine at Clarksfork, as the company is shipping about two carloads of ore a month. New stopes in the Pugh veins are now being opened. Congressman Compton I. White is president and treasurer of the company.

✦ Harry Pearson has completed the 2-mile tunnel for the Polaris Mining Company after 22 months of continuous operations. Driven through the Silver Summit property to the Polaris, making a connection with the 1,020 level of the Polaris shaft, it is now the main operating unit for the Polaris-Chester groups. The new Polaris 300-ton mill is under construction.

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South Dakota

✦ Homestake Mining Company, located at Lead, has installed two new 5,000-cu.ft. air compressors in a new building where all compressor units will eventually be located. Guy Bjorge, general manager, announced recently that on Dec. 18 the company will give each employee a bonus check of $100. A bonus of $50 was paid to employees last June.

✦ The Consolidated Feldspar Company, at Keystone, operating a feldspar mine and mill, is now employing 80 men. M. Suson is in charge of operations.

✦ Empire Gold Mines, at Hill City, has completed rehabilitation of its mine and mill, and operations are now under way. J. M. Uppercue is president.

✦ Canyon Corporation, operating a mine near Maitland, uses natural gas, piped from Deadwood, in its roasting process. L. B. Evans is in charge of operations.

✦ Anaconda Mining & Milling Company, at Roubaix, is preparing to install a cyanide plant.

✦ Bald Mountain Mining Company, at Trojan, is building a high wall to retain the tailings from the company's 300-ton plant.

Nevada

More Options in the Awakening District

DAYTON CONSOLIDATED Mines Company plans development near Jumbo property

✦ Extension of a branch of the Boulder Dam-Pioche power line to Round Mountain was discussed at a meeting of officers of the Lincoln County power district and representatives of the O. A. Smith Corporation, of Milwaukee, which has an option of purchase on the large Round Mountain properties of the Nevada Porphyry Gold Mines. The district already is served by the Nevada-California Power Company, but the proposed Pioche line would pass near Delamar and several other mining districts.

✦ Camp equipment has been provided at the Jungo Star Gold Mines Company and work is in progress under the direction of S. H. Brady, of Reno, formerly manager of the Belmont and other Tonopah mines. C. D. Terwilliger, president of the Clover Valley Lumber Company, is head of Jungo Star.

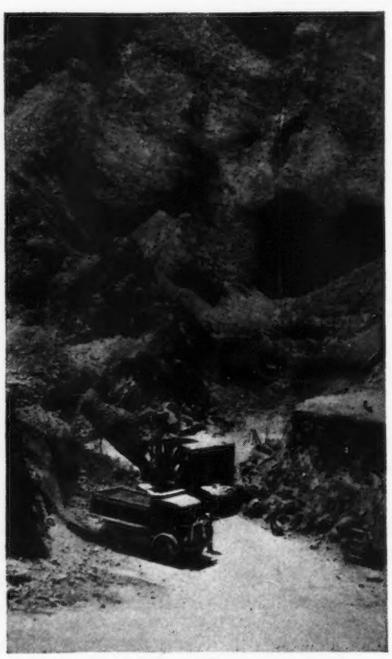
✦ Litigation has come to the Awakening district in Humboldt County, site of the widely publicised Jumbo gold property of the Austin family, in the form of a suit filed by Walter E. Trent, who has been operating with success near Mojave, Calif. In his complaint Trent charges that he and the late Gurney Gordon, widely known Nevada mining man, were associated by agreement with George B. Austin in efforts to secure an option on the Jumbo claims from Staggs and Taylor, the discoverers; that Trent advanced $50 for the costs of sampling and assays and that subsequently Austin purchased the claims for himself, paying $500 down on a two-year option with total purchase price of $10,000. Time of trial before the district court at Winnemucca has not been set, but Austin's deposition was taken there recently.

✦ An option on claims lying north and west of the Austin's Jumbo mine, at Awakening, has been relinquished by R. W. Hanna, of San Francisco, vice-president of the Standard Oil Company of California. Owners of the claims, including members of the Austin family, were said to have refused to extend the option without a substantial cash payment. J. D. McPherson, in charge for Hanna, said that prospecting the ground and driving a tunnel had failed to expose any ore.

✦ Homer L. Gibson, executive head of the Dayton Consolidated Mines Company, operating a 150-ton cyanide mill below Silver City, Lyon County, together with the Dayton, Kossuth, Keystone, and Justice-Woodville mines in that area, has verified the report that his company has taken over two groups and several adjacent claims adjoining the Austin's Jumbo mine, at Awakening. Equipment and housing facilities are being provided, he said. One group had been taken under option by J. B. Haffner, manager for the Consolidated Coppermines Corporation, of Kimberly, near Ely. This arrangement is attributed to the interest in Consolidated Coppermines of John C. Higgins, one of the heads of Dayton Consolidated.

✦ Following completion of a new pipe line to the millsite, the old Berlin silver-gold mine, owned for many years by the Stokes estate of New York, is being reopened under option of purchase by William G. McIntyre, also of New York, with Ralph Osborne as superintendent. The mine was productive of gold and silver under former operation, first with a 30-stamp amalgamating mill and later with a 30-ton cyanide mill.

✦ Eastern Exploration Company, subsidiary of Calumet & Hecla Consolidated Copper and operating properties of the Goldfield Consolidated Mines and the Goldfield Deep Mines Company under option of purchase, is said to have shipped upwards of $300,000 in high-grade gold ore within the year. Surveyors are seeking a water supply from springs along the basalt escarpment south of the town, indicating the purpose to construct a large-capacity mill. The company has made a first payment on the Tom Rea copper property, 13 miles south of Goldfield, which was developed to a depth of 350 ft. several years ago by the late Senator William A. Clark, of Montana. The copper ore is in the form of replacement deposits in limestone. Electric hoists and massive headframes have been provided at the Clermont, Grizzly Bear, and St. Ives or Merger shafts, the last named on Deep Mines ground. The Eastern Exploration lately purchased the Simmerone mine, northeast of the St. Ives.



ORE IN OPEN CUT is loaded by power shovel and trucked to the 500-ton mill of the Arizona Comstock Corporation, in Virginia City, Nev.

✦ A leasing organization has undertaken the reopening of the Golden Chariot gold-silver-copper mine, at Jamestown, 32 miles east of Goldfield. Idle since 1912, the mine formerly shipped some ore of high grade. Carl Fuetsch, now at Goldfield, is chief owner of the property.

✦ Arizona Comstock Corporation, operating a 400-ton flotation mill and central group of mines on the Comstock lode at Virginia City, treated in October 12,066 tons of ore, nearly all from surface operations. Metal recovery was $51,503.20, a high since the project started in 1933. Total tons treated to end of October were 289,292 at $5.95 per ton, or gross value of $1,722,154. This is exclusive of 512 tons shipped to smelter, returning $34,731.

✦ Effective Nov. 1, the wages of all surface and underground workers at the Mountain City Copper mine, Elko County, Nev., and at the Walker mine, at Plumas, Calif., were increased 25c. a day. Announcement of this increase was made by J. O. Elton general manager of the International Smelting Company. About 250 men were affected at the Mountain City property and 450 in California. Earnings of Mountain City Copper have been greatly increased by the rise in the price of copper.

✦ E. W. Hoffer, Addison Cain, and George H. Garnick, of Salt Lake City, head a company which has reopened the old Shields mine near Hamilton, Nev., after fifteen years of inactivity. A 100-ton mill equipped with a crusher, jigs and a Wilfley table has been installed. Repairs are being made to the 600-ft. tramway by which the ore is brought down from the tunnel. The ore, a silver-lead, occurs in beds adjacent to fissures.

✦ The Southwestern Engineering Company has started construction of a new 300-ton cyanide unit for the Weepah Nevada Mining Company at Weepah. The most recent improvements and equipment are incorporated in the design of the mill, which is expected to be in operation by Feb. 1, 1937. Walter Haggerty is managing director.

NEWS FROM WASHINGTON

By Special Correspondent

POLITICS CONTINUES to dominate Washington, even though the election is over. However, this is neither strange nor undesirable. Politics is the engineering of social science. As such it is important.

The mining and mineral industries trying to appraise trends of official activity will do well to weigh them on the social-engineering balance. Only by such a scale can proper weighting be determined. Wishful forecasting that neglects the social consequences of political action is almost sure to be wrong during the coming year.

Metal Speculation

Washington does not like the speculator. Hence officials have paid particular attention lately to the antics of the markets of tin and platinum. The quasi-official interpretation of these, and of the silver-price situation, is interesting.

Those who bought platinum for "hoarding" may have been justified if they really intended to keep the metal. In about this language officials recognize the intrinsic convenience of keeping such a luxury metal as a hedge against inflation. But those who bought platinum simply because it was rising in price, were, in official thinking, mere suckers. Easily available official data show that new sources of platinum readily could be tapped any time if supplies were in bona fide demand. Trying to outbet speculators in a rising market was, therefore, a sure gamble—sure to lose.

The threat that Siam would not continue in the tin Cartel, combined with a war scare and real commercial-stock shortage, justified tin price advances. In fact, some officials think tin stocks might be a better hedge against inflation than platinum. The main disadvantage is the relatively great bulk per dollar so stored. By the official interpretation a re-established and extended Cartel would treat more of advantages of another sort.

When there was fear that the Cartel would not survive and then a week of "celebration" when it did, the price of tin fluctuated much more in two weeks than in the previous three years. One can only conclude, says Washington, that the Cartel has had a real stabilizing influence. And officials think that American users are better off under a conservative Cartel with stable prices than they are likely to be with wide swings in markets speculatively controlled. Of course, the officials know that this preference for Cartel control does not extend to those who seem to like to buy their tin on swings in the market. But figures available indicate that such speculative consumer-buyers are not really as well off as they think. "Those who buy in direct proportion to use get their metal cheaper in the end."

The silver price speculator is appraised in still a different fashion. He simply tries to outguess the officials who make silver policy. Career officials, at least, like him least of all.

Now It's Pan America

● The President in Latin America seeks peace and trade. Washington, and perhaps the President too, have difficulty in deciding which is the more important motive of the unusual visit to the Pan American conference. But no one well informed in Washington ways doubts that an early result will be more Latin-American bilateral tariff agreements. Such trade pacts with Europe are hard to mature just now. The reason is obvious. Latin America becomes, therefore, Mr. Hull's trading ground; and he will trade with respect to minerals and metals quite as freely as in the arena of agricultural competition.

Silicosis

About the middle of December four important committees working on silicosis prevention with the Department of Labor will hold a meeting with the Secretary in Washington. At that time a program will be formulated for a National Silicosis Conference to be held probably on Jan. 14 and 15. At that second meeting a substantial number of interested executives will be invited to be present to share in the benefits of the committee reports and recommendations.

Many executives will unquestionably find much of importance in the four committee reports, which deal respectively with engineering control; medical control; economic, legal, and insurance problems; and regulatory and administrative phases. In every aspect of the case the need for additional education seems clearly indicated; as one participant in the conferences says, "We need to teach industry the best practice far more than to legislate." But labor leaders speaking through A. F. of L. are contemplating that legislation will be undertaken in many states during the coming winter. The opportunity will be adequate, for more than forty state legislative sessions are scheduled.

In most cases the wanted new law will take the form of a wider definition of compensable hazards. Silicosis will be defined as an occupational disease under the law if labor leaders have their way. As a consequence, new force will be given to state inspection and regulatory groups, and workmen's compensation insurance rates are likely to rise sharply.

Hiring employees for many types of work will require careful medical examination under new conditions, Washington believes. Labor leaders are opposed to such medical examination as a criterion of getting a job. They are even more worried by a tendency, notable in certain districts, for employers to refuse positions to men who have ever been employed by certain firms whose neighborhood reputation is not good.

Some personnel offices have, in effect, established virtually a blacklist of previous employers whose workers are never engaged. The necessity for this is explained by one management through a single experience. The company concerned had an employee very briefly in its employ who developed unquestioned symptoms of silicosis. His employment could not possibly have given him such disease. It had been incurred during previous employment in a neighboring mine where dust conditions were known to be very bad. But the new employer had to pay the bills. If medical examination will not altogether preclude the engagement of such persons already afflicted, more employers are necessarily going to develop and maintain such blacklists. They are not wanted by personnel offices, still less by workers. That an alternative equally effective would be welcome is obvious.

Recycling of Metal

The recycled purchased scrap of the iron and steel industry furnishes about three-fourths as much metal for each year's metallurgical operations as does primary ore. Scrap recycled within the home plant furnishes a like amount. In other words, the virgin metal in America's iron and steel production is only 40 per cent of the total. In the case of tin the secondary supplies care for 15,000 out of a total of 70,000 long tons of annual demand. These and many other important facts are disclosed by two statistical inquiries

published apparently by the Bureau of Mines. They represent the type of inquiry the Bureau proposes to extend to other metals—copper, lead, zinc, and so forth. The limiting factor is, of course, available funds for these economic investigations.

Government officials point out that these considerations of secondary supply are rarely as well understood, even in the industries most concerned, as are the factors affecting primary ore and metal. The reason is not hard to find. Secondary metal business has only recently achieved so great a part in the total for the mineral industry. And, furthermore, it has only lately graduated from the status of a junk business into the recognized company of important industrial processing.

Data on secondary metal production and marketing are somewhat more difficult to gather because the number of firms involved is greater. However, dealers and big consumers are pressing the important questions involved, and the Government is sure to give attention to them. Primary producers, as they appreciate the importance of the problem involved, will go along, it appears.

By-product Sulphur

Sulphur recovery as a byproduct of smelter operation promises to be of increasing importance to the pyrites and sulphur producers of the world, as well as a possible source of profit for successful users of the new processes. Already sulphur recovery from city gas, coke-oven gas, petroleum refinery gases, even from petroleum itself, is influencing total supplies. In many cases the recovery of the sulphur is in the form of sulphuric acid, often subsequently used for fertilizer making; in fewer instances it is anticipated that recovery of elemental sulphur will be practiced.

Incidentally, this is only part of the trouble ahead for sulphur and pyrites marketers, who face also shrinking uses of primary sulphur in petroleum, metallurgical, fertilizer, and other major markets. On top of this, Washington has watched with interest the tax increases imposed by Louisiana and Texas in recent months. The only comfort to the sulphur man is that apparently European military complications have relieved the pressure of Spanish pyrites and Italian sulphur on world markets.

Mineral Substitutes

German preparedness—and all else is sacrificed in the Reich to that end—hinges on independence with respect to metals, fuels, and food. Important information on the rate at which Hitler's supporters are progressing toward self-sufficiency is given in a series of reports being written by Charles Will Wright, American vice-consul at Berlin. In September one of these reports released by the Bureau of Mines presented the present situation and future possibilities of the non-ferrous mineral industry. Another number in that series is to be issued before Christmas discussing fuel and metal supplies.

Synthetic substitutes for petroleum are being developed through outstanding chemical engineering research and construction. A program of making not only gas but also gasoline from lignite (Braunkohle) is well advanced. By January, 1938, the Reich need no longer import liquid fuel to maintain itself on either a peace-time or military basis. Synthetic foodstuffs are definitely proved to be practical. Thus the chemist in the laboratory and the chemical engineer in the works have provided two of the three major needs. The situation with respect to minerals is a different story.

Shortage of copper, long recognized and long the occasion of worry, is being offset by several measures typical of the whole metal-mineral program. In essence this is recycling and substitution. Old equipment is being rejuvenated in such fashion as not to require more new supplies of the deficiency metals. Locomotives, it is said, are being practically stripped of copper parts; and bearings of new alloys make tin supply immaterial. Every available scrap of reclaimable alloy or metal is being saved for application to the "essential" purposes. Roofing, flashing, and other structural or ornamental parts may no longer use copper. The whole philosophy typical of American promotion of this metal is reversed. Copper must be, and is, saved for uses important to the Government. In like manner other substitutions are occurring, aluminum for tinned containers and a score more, which make for an entirely different economic relationship of these mineral commodities. The forthcoming report elaborates on this development in most illuminating fashion.

Spanish Minerals

Washington is undertaking to appraise the probable impact of a new government set up in Spain. The result can be little more than speculation with respect to speed of developments, but some of the inevitable consequences arising from the present turmoil appear clearly defined. One might describe informed official opinion about as follows:

Spain will become Fascist. As such it will be under the domination of Italian leadership, regardless of the apparent political independence. The Spanish rebellion will reward Mussolini in much greater degree than did the far more costly conquest of Ethiopia. Perhaps most important of all will be the newly available low-cost supplies of pyrite, lead, quicksilver, and potash. To a lesser degree the new supplies of copper, zinc, and phosphate will be helpful.

All of these advantages may lie many months, perhaps several years, in the future. Immediate restoration of production at mines now out of action will take time, skill, and some new money. But among the results to be expected, some of large world importance, perhaps the outstanding are:

1. Continued control by the cartel (Spanish-Facist and Italian interests) of the cheaper quicksilver supplies.
2. New reserves of iron ore highly essential for enlarged Italian ferrous metallurgy.
3. A weakening of the British iron and steel position.
4. New supplies of lead, or smaller new supplies of zinc, highly important to balanced Italian industry.
5. An opportunity for policy control in world price fixing of minerals, even without nominal political or commercial ownership.

No Patent Pools

Several important bills modifying present patent laws will be before Congress in January. Most important of the group for the mining industry will be the proposed legislation restricting the rights of industry in the pooling or cross-licensing of patents. Manufacturers of electrical equipment, radio, air craft, and other products, several of whom were under fire in committee hearings last winter, will not be the only ones shelled this time.

Varied methods of restricting patent pools have been proposed. The only plan commanding much support of thoughtful patent attorneys would not actually limit licensing or pooling but would require those taking licenses to make public record of the fact. It would then become a duty of the Federal Trade Commission to scrutinize such files so that any excessive licensing contrary to the Sherman Law or the Clayton Act would be promptly detected.

Such license-recording law would be self-policing, if it included one provision: that a license under a patent would not be regarded as valid unless it was recorded in Washington. Proponents argue, probably rightly, that it is of just as much importance to the public to be able to determine from official records who has a *license* under a patent as it is to determine, as is now possible, to whom a patent has been *assigned*. Such legislation might find general support, even though it would not have that anti-monopoly kick which the more ardent proponents of anti-pooling legislation have sought.

Early Production From Globe Mine

MICHIGAN COPPER companies are active — Quincy may produce in March

✦ Production from the Globe property of the Copper Range Company in Michigan is expected early in 1937. Sinking the Globe shaft is proceeding steadily toward the eighteenth level drift from the Champion. Good ground opened in the Globe may lengthen the life of Copper Range for many years. Copper ore from the last 800 ft. on the eighteenth level indicates a commercial vein comparable to that now being mined in the Champion. The ore also contains silver; each ton of blister copper is reported to contain 74 oz. of the metal. Exploration thus far has revealed a mineralized lode 3,700 ft. long.

✦ Calumet & Hecla Copper production is coming from the Conglomerate shafts, the Lake Linden reclamation plant, and the Ahmeek amygdaloid mine. Shafts Nos. 2 and 4 on the Conglomerate are almost worked out, and this leaves only Nos. 6 and 7 Hecla to operate. Mining is confined to the shaft pillars and old stopes.

✦ Mining operations at the Quincy mine, now being reopened, probably will not begin until March. Both mill and smelter may go into operation later.

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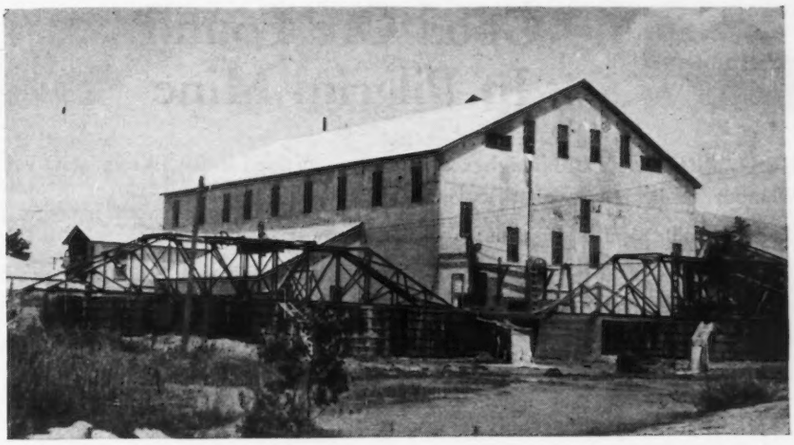
Mining Companies Plan Work During Winter

WAGE INCREASES given to miners in Lake Superior region

✦ Announcement of a 10 per cent wage increase became effective Nov. 15 at all mines in the Lake Superior district. Practically all of the mining companies are planning general winter work and stripping programs as long as weather permits, but repair gangs will be employed all winter. Wisconsin Steel Company will operate the Sargeant, Bruce, and Agnew underground mines this winter. Republic Steel Corporation will operate the Alexandria; and the Snyder Mining Company, the Webb. Oliver Iron Mining Company will operate four or five mines throughout the winter.

✦ A new mine will be opened in Virginia, Minn., and it was announced that the Lebanon Iron Company and others have petitioned the local council for permission to vacate certain areas of land near the Duluth Missabe & Northern Railway Company's station. Lebanon Iron Company is a subsidiary of Oliver Iron Mining Company.



NEW TAILING MILL of Captain Milling Company, on Wilbur land, near Treece, Kan. The plant has a capacity of about 3,000 tons of tailings per day

Tri-State

Baxter Springs Section Active

✦ St. Louis Smelting & Refining Company has completed a shaft on the Clark land, southwest of Baxter Springs, Kan., according to H. H. Utley, of Baxter Springs. The St. Louis company has been pursuing a development campaign in the Baxter Springs section for several years. The Ballard mill of the company may be converted into a central plant to treat ores from the district and operated on the same basis as other large central mills in the region.

✦ Mechanized mining methods used in some of the Northern iron mines and Western metal mines are to be tried in the Tri-State district. The Webb City Lead & Zinc Company, operating in the Oronogo section of the Missouri district, according to Clint Niday, of Picher, Okla., will install a mechanical mucker which will be used in the old D. C. & E. mine. The company recently tried hand-sorting of ore from the mine and succeeded in raising the ore grade. It is believed that by reducing the size of the working face from 6 to 7 ft., to 3 and 4, a higher grade of ore can be shipped to the Central mill of the Eagle-Picher Mining & Smelting Company.

✦ Commerce Mining & Royalty Company, H. W. Harrison, of Miami, general superintendent, has closed the Bird Dog mill temporarily while the twelve Butchart flotation machines are replaced with Mineral Separation equipment. The company has completed a new all-steel ore bin at the Bird Dog mill for concentrates, and soon a bin for coarse ore will be constructed.

✦ The New Deal Mining Company, operating the old Kitty lease, west of Picher, expects to reopen the mine soon, according to Jack Davis, of Picher, Okla.

✦ The Mission Mining Company is moving its mill from the Lincolnville district to south of Hockerville, according to Joseph Heilman, of Baxter Springs. The company has obtained a lease on the Weiss land, formerly mined by the Evans-Wallower Lead Company.

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World Zinc Production Shows Upward Trend

World production of zinc during October amounted to 142,497 short tons, the highest monthly total so far this year, according to figures compiled by the American Bureau of Metal Statistics. Out of the total produced, 46,297 tons were made in the United States and 96,200 tons abroad. In September, world output amounted to 134,083 tons, and in October last year 125,992 tons.

The following table gives world zinc production, by countries, for September and October, in short tons. Returns for Italy and Spain are missing, but estimates for them are included in the totals.

	Sept.	Oct.
United States	42,283	46,397
Other North America	16,318	17,576
Belgium and Netherlands (a)	19,400	20,900
France	3,620	5,107
Germany	12,346	12,346
Italy (a)	(c)	(c)
Rhodesia	1,904	1,904
Spain	(c)	(c)
Anglo-Australian	12,453	12,600
Elsewhere (b)	22,800	22,800
Totals	(d) 134,083	(d) 142,497

(a) Partly estimated. (b) Includes Norway, Poland, Japan, and Indo-China, with estimates for Czechoslovakia, Yugoslavia, and Russia. (c) Not reported. (d) Totals include estimates for Italy and Spain.

Production of zinc by primary metallurgical works in the first ten months of 1936 amounted to 1,339,377 tons, against 1,233,349 tons in the same period last year.

Good Ore Found In Pilgrim Mine

METAL PRODUCTION higher for November as a result of discovery

✦ Pioneer Gold Mining Company, operating the Pilgrim mine, in the River range 9 miles west of Chloride, in Mohave County, has developed new ore, some of which carries high grade. It is reported that in the first eight days of November metal production exceeded any previous full month record. M. C. Richardson is mine superintendent an E. F. Gastings, Jr., is manager.

✦ The Henderson mines, near Placeritas, owned by the Bragg estate, have been taken over by A. T. Russell, of Kirkland. The milling plant has been completed and production started.

✦ Castle Creek Mining Company, operating 20 miles north of Wickenberg, is actively engaged in mine development on the Buckhorn group of eight claims. This property is credited with a production of around three million dollars. D. M. Critchley, a Los Angeles, Calif., attorney, is president and counsel for the company. J. L. French, of Wickenberg, is vice-president. A large area of profitable placer gravel is reported to be part of the company's interests.

✦ The Iron King shaft, situated about a mile west of the old Humboldt smelter, is being unwatered. The property is developed by two shafts, one 435 and the other 225 ft. deep. Previously, the property shipped to the smelter several thousand tons of ore averaging $8 a ton in gold and silver. Plans are being made for the construction of a mill to treat the low-grade ores. Howard H. Fields, of Prescott, is in charge of operations.

✦ Myers Walters and associates have completed their new 25-ton flotation mill on the Payoff property, near Groom Creek, Yavapai County, and have started production.

✦ Lester Jacobs and associates, of New York, are planning the erection of a mill on the Rebel property, near the old McCabe, in the Humboldt district. The equipment of the Ora Flame mill has been purchased and will be moved to the Rebel mine. About 8,000 tons of ore of milling grade is estimated to be in the dump. The shaft is 900 ft. deep and the mine is reported to contain blocked-out milling-grade ore.

✦ The Southwestern Metal Company, operating the French Lily mine, near Cleator, is continuing its extensive development program. Two shifts are employed in the mill and three in the mine. A third shift will soon start work in the mill. H. P. Morgan is president of the company and general manager of the property.

✦ Bradshaw Mines, Inc., have leased the Storm Cloud group of claims in the Groom Creek country. The company is now handling about 80 tons of ore daily. The property is owned by M. J. O'Brien, of Ottawa, Canada, and is represented in Arizona by G. M. Colvocoresses, mining engineer of Phoenix. H. L. Williams, of Prescott, is general manager.

✦ American Metal Company has started diamond drilling on the San Juan zinc properties on the south slope of the Dragoon Mountains near Tombstone. The property contains 200 acres of ground. Charles E. Stott, general superintendent of the company's mine at Shafter, Tex., has been contracting the drilling. The property is owned by Mrs. Jonathan Gordon, of Tucson.

✦ The Gold Standard mill, at Katherine, is running steadily, treating ores from the Portland, Minnie, and Sheep Trail mines, operated by the company. Plans are being made for increasing the capacity of the mill. At present about 240 tons are treated daily.

✦ Boriana mine, east of Yucca, has lately opened up some parallel veins which contain tungsten ore. The mill is operating steadily and concentrate shipments are being made regularly. About 115 men are employed at the mine and mill. The Boriana claims to be the second largest tungsten producer in the United States.

Three Districts Produce Base-Metal Ores

TWO SMELTERS provide the market for siliceous and basic Montana output

✦ Exclusive of the Butte district, mining activities in Montana are directed essentially toward the development and operation of gold properties. Three districts produce ore which is not predominantly gold bearing. They are the Philipsburg, Basin, and Hog Heaven, where complex lead-zinc-silver ores predominate in the first two, and silver in the third. Outstanding in the Philipsburg district is the operation of the Trout Mining Company, which is equipped with a concentrating plant. Next in importance is the Two Percent Mine, which ships silver ore.

✦ In the Basin district the largest single operation is the Basin Montana Tunnel Company, which operates a mill and produces lead and zinc and an iron concentrate containing the gold. The flotation plant is situated at the Comet Camp, but ores are secured from the Comet and the Grey Eagle mines.

✦ In the Hog Heaven district, in Flathead County, the Flathead mine of the Anaconda Copper Mining Company is the important producer. From 70 to 100 tons of silver ore are shipped each day. It is interesting to note that accessory lead content is not recoverable under the present operating method, and alternate schemes are ruled out because of the presence of bismuth in objectionable amounts.

✦ During recent years there has been a well-defined trend toward the development of lower-grade, less selective operations, which implies a substantial increase in milling facilities throughout the State. Thus, a definite increase in stability of production is evidenced, with a corresponding decrease in production of the sporadic, high-grade character.

✦ Features governing the marketing of gold ores and concentrates in Montana are found in two centrally located ore buyers who accept ore shipments of opposite characteristics. Two types of ore constitute the bulk of Montana production; therefore marketing may be considered exceptionally favorable in the Montana area. The East Helena plant of the American Smelting & Refining Company favors shippers of high-iron gold ores, whereas the Anaconda Copper Mining Company favors shippers of siliceous ores. Average ores then may be marketed under competitive circumstances, but extreme ores, be they either of the basic or siliceous variety, may be marketed on a premium basis. In addition, sales of products of milling of complex ores are favorable, since either one plant or the other receives any product prevalent in the area. This condition is in a large way responsible for the stimulation of development of Montana ores throughout a wide range of types.

✦ In the Little Rocky Mountain district, two operations are at present outstanding. These are the Little Ben Mining Company, and the Ruby Gulch Mining Company, which handle respectively 100 and 300 tons daily. High-grade ores exist at both properties, but neither can be classified as having that type of deposit. In the Ruby Mine, non-selective methods are employed, and it is planned ultimately to mine

low-grade ore bodies several hundred feet in width. The ores of the Little Rocky area are particularly adapted to extraction by cyanidation. The most interesting feature in this regard is that the crush employed at the Ruby mill is to ¼-in. size. Both plants are diesel powered and neither operation is greatly inconvenienced by the fact that the distance to the nearest railroad is approximately 100 miles.

✦ The Bald Butte Gold Mines tailings and mill camp and the 400-ton flotation plant of the Atlas Mines Corporation have been leased to Frederick B. Hyder, 909 Kemp St., Burbank, Calif. Mr. Hyder expects to start operations in the spring on these properties and that of the Larsen tailings. The tailings dams are near Marysville, Mont.

✦ Anaconda Copper Mining Company and subsidiaries earned $9,940,132 in the first nine months of 1936, according to the preliminary consolidated income account. For the same period last year the net income was $7,856,153.

✦ The Trout Mining Company recently consolidated with and into the American Machine & Metals, Inc., the parent company. The Trout company has since 1925 been operating its properties at Philipsburg, producing manganese ores, which are sold principally to dry-battery manufacturers, and silver-lead-zinc ores. American Machine & Metals, Inc., will continue operations at Philipsburg, and this department of its business will be known as the "Trout Mining Division." There has been no change in the personnel managing the company, and operations will continue under the direction of Charles A. Hyder, manager, and Hans J. Stockder, the assistant manager.

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Oregon

✦ The Horse Heaven Mines, Inc., located near Ashford, have been taken over by the Sun Oil Company as a subsidiary for the production of mercury. J. Edgar Pew, of 905 Public Service Bldg., Portland, is president of the mining company. The Sun Oil Company uses a mercury vapor process for the refining of petroleum and by taking over these mines it is assured of its mercury supply in this country.

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Washington

✦ A new 100-ton mill has been completed at the Azurite mine, in the Washington Cascades, under management of Federal Mining & Smelting Company, and is now in operation following two years of mine development. The property is reported to have several million dollars' worth of gold-silver-copper ore available for treatment.

Utah

Negotiations for Strike Settlement Under Way

MINERS IN TINTIC district return to work—Lakeside Monarch Mining Company to build mill

✦ The strike of metal miners for a wage increase of 50c. daily still continues at Park City and Bingham, with maintenance workers still on duty to keep the mines in condition for resumption. On Nov. 11 miners in the Tintic district and employees of the International Smelting Company at Tooele voted to accept the offer of an increase in pay of 25c. daily and "no discrimination" against union members. A similar offer by Park City and Bingham lead-silver mine operators was voted down by members of the International Union of Mine, Mill and Smelter Workers. At Bingham, non-union workers by a vote of 72 to 1 favored returning to work, but the mines of the United States Smelting & Refining Company remained shut down pending further negotiations.

✦ Lee Lakin and associates, who have taken a lease on the Columbus Rexall Consolidated Mines at Alta, have completed the installation of a compressor, building of snowsheds, and connection of the mine with the Utah Power & Light Company's power line. A branch air line has been laid to the No. 3 shaft, where work will be carried on through levels below the main Rexall tunnel. Funds for the improvement of the road by the WPA into Alta have been assured, and this important work will be resumed just as soon as the ground is clear of snow next summer.

✦ Erection of a mill on the property of the Lakeside Monarch Mining Company property in the Lakeside range, 17 miles north of Delle on the west side of Great Salt Lake, is planned, according to the manager, George H. Short, and work of erecting the plant two miles east of the mine will begin at once. The plant of 100 tons' daily capacity will combine gravity concentration and oil flotation. A diesel plant will supply the power. Tests indicate that the ore will concentrate at a ratio of 4.2 tons to one and yield a 55 to 65 per cent lead concentrate. Recoveries are expected to average 92 per cent. A large tonnage of ore carrying 15 per cent lead and 30c. gold to the ton has been developed.

✦ Tintic Standard Mining Company has successfully completed its first test drilling operation on its property in the Tintic mining district near part of the Silver Shield Mining Company's property under option of the former. The test hole was drilled into the Ophir formation of limestone and shales, very similar to that in which the Tintic Standard orebodies are found. The log of the hole showed as follows: lava overburden, 415 ft. thickness; lime and shales 468 ft., and at the combined depth, 883 ft., quartzite was encountered. Operations are now being conducted closer to the Silver Shield shaft and a short distance from the claims under option from the Silver Shield company.

✦ Utah Copper Company won the first round of a legal battle contesting the State of Utah and Salt Lake County's right to $100,000 in taxes alleged to have been illegally collected for the year of 1934. On Nov. 7, Judge Tillman D. Johnson of the United States District Court ruled that the Utah Copper Company prepare findings in accord with his decision, after which he would award judgment in its favor. The question involved in the suit is whether the State Tax Commission had the right to include as gross proceeds a quantity of copper sold in 1934 but held over from other years. This interpretation of the law, the Utah Copper Company held, would subject it to recurring excessive taxation until the copper stocks built up during previous years had been sold. The case will probably be carried up to the United States Circuit Court of Appeals in an effort to settle the point whether gross proceeds under the Utah law should include all of the metal sold during one year, even though some of it is carried over from the preceding year. Affirming their stand that dust from the Utah Copper Company tailing dumps constitutes a public nuisance, attorneys for Thomas L. Thomas and 250 other Magna residents recently filed a brief in Judge Tillman D. Johnson's court. This is one of the closing steps in a suit to recover damages from the Utah Copper Company. The plaintiffs allege that the tailings dump is a growing menace to health and happiness. Evidence was introduced at the hearing to show that the dust invaded homes, damaged goods in stores, deterred growth of plants, and befouled the air.

✦ Prospecting in the Apex Standard mine, near Eureka, by the Chief Consolidated Mining Company is producing from two to three carloads of ore weekly averaging 25 oz. of silver to the ton, 0.2 oz. gold, and 6 per cent lead, with low content of copper. The ore occurs in the quartzite. At times, high gold content occurs. One carload of this type of ore netted the management $3,000.

HARD ROCK GOLD MINES, LTD., in the Little Long Lac area, will have electrical energy about Jan. 1. No. 2 shaft (above), on "Porphyry Hill," is being sunk to open ground drilled by the Homestake Mining Company in 1932

Canada

Good Drilling Results at Consolidated Chibougamau

O'BRIEN GOLD MINES find high-grade ore in depth—United States Smelting, Refining & Mining options gold property in Quebec

✦ Consolidated Chibougamau Goldfields, Ltd., reports that the results from diamond drilling on the 500-ft. level south of the present workings indicate an orebody about 10 ft. wide, containing a good grade of gold and copper ore. When this find has been developed by drifts and crosscuts, definite knowledge as to the size and value of the deposit will be better determined. Mr. Montgomery, in charge of operations, recently summarized progress on developed portions of seven veins that indicated lengths from 27 to 189 ft., with widths ranging from 1.2 ft. to 3.8 ft. On Nov. 14 the Consolidated Mining & Smelting Company held 1,100,000 shares of the 3,000,000 shares of Consolidated Chibougamau Goldfields, Ltd.

✦ O'Brien Gold Mines, at Cobalt, Ontario, are reported to have intersected high-grade ore on the No. 4 vein in the 1,260 shaft station. The shaft is being sunk to 1,500 ft. and is now close to 1,300 ft. J. G. Dickenson is general manager.

✦ Agaura Exploration, Ltd., a wholly owned subsidiary of the United States Smelting, Refining & Mining Company, has taken an option on stock of the Amm Gold Mines, Ltd., in Cadillac Township, Quebec. Surface trenching and sampling are now under way. Henry Tudor, of Toronto, is president of Amm Gold Mines, Ltd.

✦ Continued improvement in the copper market is gratifying to British Columbia and brightening the outlook for a number of properties now dormant. The 6,000-ton concentrator at Britannia Beach is now operating at 70 per cent of capacity. Howe Sound Company, of which Britannia M. & S. is a subsidiary, reports that during the quarter ended Sept. 30, 6,031,507 lb. of copper was sold, compared with only 3,076,164 lb. in the corresponding quarter of last year.

✦ Granby Consolidated Mining, Smelting & Power Company has had its charter altered by the passage of a private bill in the Provincial Legislature in accordance with the decisions reached at a recent meeting of shareholders. It is also understood that as a consequence of the higher price of copper, the Vancouver Island property of Coast Copper Company may be reopened.

✦ Another shipment of 500 tons of nickel-copper ore has been made from the B. C. Nickel Mine, at Choate, to Japan, where it is understood it is being used for testing in metallurgical work. The shipment is the third in recent months, and brings the total to 1,500 tons. Meanwhile, development of further reserves is proceeding by diamond drilling and tunneling under the direction of Major C. B. North, general manager. Ore reserves at the B. C. Nickel mine, in the Yale district, are estimated at 1,042,000 tons, averaging 1.41 per cent nickel and 0.46 per cent copper, of an average value of about $11 per ton. A 500-ton concentrator is considered.

✦ Pioneer Gold Mines, Ltd., in the Bridge River area, will make its regular quarterly dividend payment of 20c. a share on Jan. 2, 1937. A. E. Bull, secretary, reports that as a result of the heavy program of development intended to double the depth of the mine, production in forthcoming months will probably be restricted to about $170,000. In 1935 the average monthly output was $250,000. According to the general manager, Dr. H. T. James, results obtained in the lower levels to date have been gratifying. Drifting between levels 14 and 23, which has been confined to 1,500 ft., or about half the known length of the vein, has indicated approximately 300,000 tons of ore, averaging 0.40 oz. gold per ton.

✦ Congress Gold Mines, whose property adjoins the Minto, has purchased from the Meridian Mining Company milling machinery capable of treating 100 tons a day. T. C. Botterill is manager of Congress Gold Mines, in British Columbia.

✦ At the Island Mountain mine, near the town of Wells, and across Jack of Clubs Lake from the Cariboo Gold Quartz, the shaft from the main adit level has been sunk 500 ft. and lateral work started. M. D. Banghart is manager.

✦ The capacity of the Hedley Mascot mill, in the Osoyoos district, has been increased to between 170 and 180 tons, and it is planned to install additional equipment within three months which will raise the capacity to about 250 tons. Development work has indicated ore reserves are far in excess of the original estimates. W. R. Lindsay is in charge.

✦ At the Gold Mountain mine, near Hedley, a 50-ton flotation mill is being installed. It is expected it will be ready for operation in December. Frank Dollemore is mine superintendent.

✦ In the Nelson district satisfactory progress is being made at a number of properties. Two new 100-ton mills commenced operations in October—one at the Kootenay Belle, in the Sheep Creek camp, and the other at the Wesko, in the Ymir area. The cyanide plant at the Kootenay Belle was started on Oct. 26. The company has also constructed new camp buildings accommodating 100 men. Vere McDowell is manager.

✦ Milling at the Meridian mine, in the Lardeau district, was suspended recently due to the lack of available commercial ore. Sampling by the late management indicated ore in the Highland Mary glory hole averaging 0.25 oz., and a tunnel was driven to mine this area, but actual recoveries averaged only 0.10 oz. It is now proposed that the 100-ton mill be dismantled and machinery sold to another operating company in the Province in return for a substantial stock interest. The power plant and mining plant would be maintained in good condition in the event that at some future time further exploration work may be undertaken.

Africa

Nchanga-West Copper Mine To Be Reopened

RICH WORKINGS flooded in 1931 will be unwatered—Cobalt an asset at Nkana

✦ Analysis of Rhokana Corporation's report for the year to June 30 brings to light the importance of the cobalt which it is recovering from its ores in the smelting process, not in refining. For instance, Rhokana produced 50,399 long tons of copper and sold 924,842 lb. of cobalt in alloy and refined products. The price of cobalt, controlled by international agreement between this company and other producers, is 6s. per pound of refined and 5s. in alloys. Rhokana's income from cobalt sales is estimated to be £5 per long ton of copper it sold last year. Not so many years ago cobalt in the ore was considered a misfortune. Nkana ores are estimated to contain slightly over half a pound of recoverable cobalt per ton. As re-estimated last year, Nkana now has 125,674,435 short tons of proved ore averaging 3.50 per cent copper. The Nchanga area containing 143,780,000 tons of ore averaging 4.66 per cent copper is to be taken over and developed by a subsidiary company. The new company will unwater the shafts and workings which Rhokana abandoned after they were flooded in 1931, and then develop the rich Nchanga-West deposit. This portion contains 46,500,000 tons of 6.9 per cent ore, 6,300,000 tons of which averages 17 per cent copper.

✦ A report by Sir Robert Williams & Company states that up to Sept. 30, 11,600 ft. of underground openings had been made in Kentan Gold Area's Geita (Muinto Dineiro) mine. The average assay of 71 samples is 6.14 dwt. over widths averaging 100 in. Preliminary tests on the ore indicate that it is suitable for cyanide treatment, with high recovery and low cyanide consumption. The management also expects to have 1,000,000 tons of 6-dwt. ore developed ten months hence on Ridge 8 (Nyamoririma). The plan is to erect a 500-ton mill as soon as the ore tests are completed.

✦ Mufulira's production quota has now been greatly increased and operations are getting into an area of high-grade ore. Quarterly statements are expected to reflect the possibilities of this remarkable copper mine. Mufulira's production costs are expected to be reduced rapidly.

✦ Developments in the properties of East African Goldfields have continued favorable, and financial arrangements are being made for the erection of a mill and other necessary plants.

✦ Kwahu Mining Company announces that it has arranged for the Ashanti Gold Coast Mining Corporation to supervise extensive exploratory and mining operations which are to be undertaken immediately on its extensive properties. About 20 square miles lying north of the Marlu Gold Mining Area's holdings is now being explored.

✦ Rhodesia Broken Hill Development Company is reconstructing its capital with a view to raising funds for the erection of a concentrator. The company's mine was worked at first as a lead deposit. When the lead oxides were exhausted it became apparent that it was a zinc mine, and it accordingly was equipped for the production of approximately 20,000 long tons of electrolytic zinc annually. Deeper drilling has since revealed large tonnages of mixed ore containing both zinc and lead. With a concentrator the company will again be a lead producer while continuing the production of zinc. Great distance from markets has made zinc production hardly profitable on the low prices of the past few years.

✦ What Roan Antelope has accomplished, under the handicaps of low copper prices and restricted output, since June 1, 1931, when its concentreator went into operation, up to June 30, 1936, is shown interestingly by the following figures:

Income from sale of 237,382 long tons of copper..		£7,609,986
Payments from income —		
Dividends.....	£597,947	
Debenture interest.....	572,959	
Debenture redemption....	61,692	
	£1,232,598	
Undistributed net assets.....	£1,086,260	
		£2,318,858
Production cost and other expenses.....		£5,291,128
Averages.		
Price received per ton.....	£32.062	(About 7c. per lb. copper)
Cost per long ton..	22.294	(About 4.857c. per lb. copper)
Profit per ton....	£9.768	(About 2.143c. per lb. copper

South Africa

✦ The only silver at present recovered in the Union of South Africa is that contained in the gold bullion produced by the Witwatersrand and other gold mines in the Transvaal and in Natal. The total output from this source from earliest existing records to the end of 1935 was 30,464,709 fine ounces. Rand ore contains an average of about 0.10 oz. silver per ton, but the proportion of silver to gold varies considerably in different parts of the gold field and in one and the same mine. Silver also occurs in variable proportions with the lead and copper ores found in the Union, but at present there is no major production of silver from these sources.

✦ A deputation from the joint mining trade unions' executive committee has interviewed the Transvaal Chamber of Mines on a request for an increase in wages by 10 per cent. The interview followed preliminary negotiations in the last few months. A written reply will be sent by the Chamber. The increase in wages refers only to white and not to native workers.

✦ It is reported from Kampala, Uganda, that all records for gold exports were beaten in September, when 1,700 oz. of gold, valued at £11,200, were won from the Uganda alluvial gold fields. This makes a total of 10,000 oz., valued at £63,500, for the first nine months of the year. The total gold export for 1935 was 6,300 oz., valued at £43,000. Tin exports for the first nine months were 430 tons, worth £62,500, compared with a total export during 1935 of 552 tons, valued at £86,000. Tantalite exports this year so far are 14 tons, valued at £4,500.

✦ Though no final figures are yet available for October, the returns of the six major groups show a marked advance over the previous month. It is already certain that both tonnages and profits will be the highest for the year. The two most important factors responsible for the advance are the higher price of gold, 141s. 6d., and the longer working month of 27 days. The following table compares the tonnage, profit, and the price of gold for the first nine months of the year:

	Tons Milled	Profit £	Price of Gold s.	d.
Jan.	3,930,760	2,675,883	140	6
Feb.	3,807,190	2,583,976	140	6
Mar.	4,031,300	2,702,301	140	6
April	3,907,600	2,613,364	140	6
May	4,021,900	2,651,190	139	6
June	4,017,600	2,634,086	138	6
July	4,138,600	2,688,426	138	6
Aug.	4,133,450	2,674,461	138	0
Sept.	4,098,740	2,599,470	137	0

It is evident that the steadiness of profits, despite the adverse factor of the declining gold price, has been attained partly by an increase in tonnage and partly by varying the grade of the ore milled. With the higher price of gold and the increased outlook for steady currency levels and ratios, it is possible that the mines will now embark on a policy of treating lower grades, with subsequent increases in tonnages and profits.

✦ The net mean annual yield to all capital invested in the South African gold-mining industry from 1887 to 1932 has been 4.1 per cent, according to Professor S. Herbert Frankel, of the Wit-

(*Continued on page* 638)

Australia

Antimonial Lead Smelter At Wiluna Makes First Run

ORE AND CONCENTRATE sintered and then smelted—New orebody at Yellowdine will be prospected

✦ The new smelting plant of Wiluna Gold Mines, Ltd., for the treatment of antimonial flotation concentrate was given its first run on Oct. 2. Concentrate is recovered from the Moonlight ore, mixed with Northampton lead concentrate and sintered on a Dwight-Lloyd machine. The sinter is smelted in a large blast furnace to give antimonial lead bullion. This bullion is softened to remove the arsenic and antimony and zincked to recover a gold-zinc crust. The process may be applied to the Wiluna concentrate later. A. Claud McDonald, formerly of the Broken Hill Associated Smelters, is in charge of the new plant.

✦ Yellowdine Gold Development, Ltd., operating at Yellowdine, Western Australia, treated 5,005 tons in September, or full plant capacity, for 2,538 oz. of bullion, valued at £20,735. The tailings, which are being stored pending the installation of a decantation cyanide plant, assayed 7.9 dwt. A new orebody has been met in No. 5 diamond drill hole. At 200-ft. vertical depth and over a true width of 28 ft. the assay was 20 dwt. per ton. This lode is to be prospected by a crosscut from an extension of the main south drive on the 200 ft. (No. 3) level.

✦ Improved results are reported from New Occidental Gold Mines, N. L., Cobar, N. S. W., under the management of Charles E. Blackett, formerly of Boulder Perseverance, Ltd., Kalgoorlie. This company recently acquired the New Cobar mine, in the same district.

✦ Ore reserves of Southern Cross United Mines, Ltd., Southern Cross, Western Australia, are estimated at 60,800 tons assaying 5.3 dwt. A treatment plant is to be installed. R. M. Perkins is mine manager.

✦ Paringa Mining & Exploration Company, Ltd., Kalgoorlie, is preparing plans for a treatment capacity of 5,000 tons monthly. Designs for the mill of Gold Mines of Kalgoorlie, Ltd., are being completed. The capacity will be 10,000 tons monthly. The ore reserves of the latter company are 210,000 tons assaying 7.4 dwt. T. W. Greenhill is mine manager.

✦ De Bernales interests have acquired an option of a new find, the Halley's Comet, at Marble Bar, Western Australia. From two crushings totaling 152 tons 1,134 oz. of bullion was obtained.

✦ Golden Plateau, N. L., operating at Cracow Goldfields, Theodora, Queensland, treated 45,075 tons for 29,212 fine ounces, during the twelve months ended June 30, 1936. The extraction was 97 per cent and the costs of mining and milling were 21s. 8d. per ton. Ore reserves are 233,640 tons, containing 93,430 oz. The plant is to be extended to treat 5,000 tons monthly. H. H. Miller is general manager.

✦ Profit of Broken Hill South, Ltd., for the twelve months ended June 30, 1936, was £486,197, or £143,687 more than in the previous period. Dividends aggregating 12s. 6d. per £1 share absorbed £500,000. Operating results for the past three years follow:

	Year Ending June 30— 1934	1935	1936
Crude ore treated tons	345,630	366,660	386,100
Assay			
Lead, %	15.8	15.3	13.7
Zinc, %	12.7	12.0	11.2
Silver, oz.	6.7	6.9	5.5
Lead conc. tons	68,454	70,462	66,382
Assay			
Lead, %	76.0	75.9	75.8
Silver, oz.	30.7	32.6	28.6
Recovery			
Lead, %	95.6	95.4	94.9
Silver, %	91.4	90.6	89.2
Zinc conc. tons	71,752	79,029	71,001
Zinc	52.9	52.9	52.8
Recovery	86.5	87.7	86.5
Working costs per ton	24s. 5d.	25s.	26s. 7d.
Ore reserves, tons	3,500,000	3,500,000	3,250,000

The increase in working costs has resulted directly from higher wages.

✦ In a preliminary announcement, net profit of North Broken Hill, Ltd., at New South Wales, for the twelve months ended June 30, 1936, is given as £322,860, compared with £256,020 for the corresponding period of 1935. H. St. J. Somerset is general manager.

✦ Tonnage of ore treated at Mount Lyell, Tasmania, has increased steadily since open-cut operations were resumed. The production of copper for the three months ended Sept. 30, 1936, was 4,428 tons, which is 1,400 tons more than the output in the previous quarter. Full details for 1936 are given in the following table:

	For Quarter Ended Mar. 31, Tons	June 30, Tons	Sept. 30, Tons
Ore treated in mill	163,517	167,334	191,352
Conc. produced	11,956	12,411	14,574
North Mount Lyell ore smelted	1,509	1,684	2,183
Conc. smelted	10,843	12,249	17,359
Total ore smelted	12,352	13,933	19,542
Blister copper produced	2,752	3,065	4,463
Contents:			
Copper, tons	2,731	3,043	4,428
Silver, oz.	22,051	23,842	33,446
Gold, oz.	1,562	1,647	2,341
Refined copper, tons	3,179	3,171	3,348

✦ Morning Star (G.M.A.) Mines, N. L., of Woods Point, Victoria, made a profit of £55,235 for the twelve months ended June 30, 1936. The mill treated 5,630 long tons for 10,307 fine ounces. The twenty-head battery plant is to be modernized and extended to give a capacity of 50 tons daily. Gold Mines of Australia, Ltd., 360 Collins St., Melbourne, are general managers.

AFRICA

(*Continued from page 637*)

watersrand University. In a comprehensive review of 50 years of gold mining on the Rand, the professor removes many misconceptions, based on inadequate knowledge, as to the nature and extent of the gold-mining industry of the Witwatersrand.

✦ One of the most important features of the industry, explains Professor Frankel, is the continuous increase in efficiency, which has resulted in a fall of costs, notwithstanding the ever-increasing depth of mining. This is largely due to the process of consolidation and merger, the extent of which can be indicated by the fact that out of 576 gold-mining companies floated between 1887 and 1932, some 206 were consolidated, 313 wound up, and only 57 remained in existence in 1932. The latter were, with minor exceptions, controlled by six financial houses or groups. Of the total Witwatersrand gold production, amounting to about 300 million ounces, 35 per cent is accounted for by six mines, which are still producing. Dealing with recent results Professor Frankel says he has estimated that during the three years to the end of 1935, the nominal capital of newly floated companies amounted to over £34,000,000. Cash invested was approximately £25,000,000. The number of new gold-mining companies registered during that period was 149. Of these 74 are carrying on operations, 27 are defunct, and 48 have ceased operations. The gold-mining industry has become of paramount importance in the economy of South Africa. In 1932 50 per cent of the direct and indirect revenues of the Government were derived from the Witwatersrand gold industry—a percentage which today is very much larger. The future of the industry, the professor concludes, will depend on the level of costs and of direct and indirect taxation, and State expenditure can be readily adopted to changing conditions. At the moment it is disquieting to find that the unprecedented activity in the building industry, caused by gold-mining expansion, is being fanned by the most lavish Government expenditure on public works and by extremely costly measures, of doubtful utility, intended to bolster up the agricultural industry.

PERSONAL ITEMS

Richard H. Vail was in New York recently from York, S. C.

Harrison Schmitt, consulting mining geologist, spent some time in New York in the latter part of November.

H. J. C. MacDonald, consulting mining engineer, is now located at 4 East 32d St., Baltimore, Md.

Enoch Perkins writes from Néhoué, New Caledonia, that he expects to return to New York at the end of the year.

B. G. MacDermid is now mill superintendent at Sigma Mines., Ltd., at Bourlamaque, Quebec, Canada.

Edward F. Fitzhugh, Jr., manager of the mining division of Equities, Inc., is at Salmon, Idaho, supervising initial production in the Ranger mine.

W. A. Vine is engaged in sampling work with the Tintic Standard Mining Company at Dividend, Utah.

John C. Bryan has taken a position with Foster D. Snell, Inc., consulting chemists, of Brooklyn, N. Y.

N. D. McKechnie, geologist, is now on the staff of the Sullivan Consolidated Mines, Ltd., at Sullivan, Quebec, Canada.

R. E. Barrett recently resigned from Parkhill Gold Mines to assume the post of manager of Central Patricia Gold Mine, Ltd., at Pickle Crow, Ont.

H. R. Taylor, consulting metallurgist, of Vancouver, B. C., has been appointed manager of the Norcal Mining Company at Sawyer's Bar, Calif.

R. W. Hayes, recently assistant manager of West Rand Consolidated, assumed the management of the Van Ryn G. M. Estates on Oct. 1.

Sydney H. Ball, of Rogers, Mayer & Ball, has been in the Western part of the country recently, on professional business.

James J. Carrigan, assistant general manager of Anaconda Copper Mining Company, has been elected president of the Montana Society of Engineers.

D. L. Mathias has joined the Metal & Thermit Corporation, 120 Broadway, New York City, in the capacity of research engineer. He will be in charge of electrode research and development.

A. J. Klamt, mining engineer, of 2335 Virginia Road, Los Angeles, Calif., is completing a series of examinations in California, Nevada, and Utah.

Edgar W. Tennis is an engineer in the mining department of Cia. Minera Asarco, S. A., Apartado 85, Parral, Chihuahua, Mexico.

G. L. H. Loram, consulting geologist and mining engineer, has left Placerville, Calif., and is now at 2108 Shattuck Ave., Berkeley, Calif.

Sir Ernest Oppenheimer has become a member of the board of Rand Leases Gold Mining Company, in place of **L. Ehrlich,** resigned. **A. S. Allen** has joined the London Committee, succeeding **E. Turk.**

Dr. George Otis Smith, a former president of the American Institute of Mining and Metallurgical Engineers, and until recently director of the United States Geological Survey, was in Hibbing, Minn., on Nov. 12. He was accompanied by **Dean E. H. Comstock** of the School of Mines of the University

GEORGE OTIS SMITH

of Minnesota. A banquet was held in his honor at the Androy Hotel and members of the A.I.M.E., together with officers and members of the Engineers Club of Northern Minnesota, were in attendance. About 100 people were present and enjoyed the talk by Dr. Smith and also remarks by Dean Comstock.

S. B. Goldberg, who resigned his position as assistant manager of Sisco Gold Mines, Ltd., some time ago, has since been appointed resident manager of all of the interests of Que-On Mines, Ltd., in Quebec.

Julian M. Avery, metallurgical and electro-chemical engineer, has joined the staff of Arthur D. Little, Inc., research chemists and engineers, at Cambridge, Mass.

H. D. Bell, Dr. A. O. Dreosti, Dr. Rudolph Krahmann, and **Oscar Weiss** were recently awarded gold medals by the Chemical, Metallurgical, and Mining Society of South Africa.

H. W. Gould, consulting engineer and member of H. W. Gould and Company, San Francisco, was recently in Oregon examining molybdenum properties in the Wallowa Mountains controlled by Portland interests.

Harold K. Hochschild, president of the American Metal Company, Ltd., has agreed to act as chairman of the non-ferrous metals division of the United Hospitals Campaign Committee, which is raising funds for the support of the hospitals of New York City. His address, as chairman, is at 57 William St., New York City.

Leon E. Charlot, for more than a year mine superintendent of Compañia San Rafael y Anexas, in Hidalgo, Mexico, has left the employ of that company to take up professional work at Manila, P. I.

Walter Rex Storms, formerly in the safety division of the United States Bureau of Mines, Duluth, Minn., has gone to Manila, P. I., where he may be addressed care of H. A. Wendt & Co.

T. P. Condy sailed from San Francisco on Nov. 12 for the Philippines, where he will join the staff of the Balatoc Mining Company, Baguio, Benguet.

John E. Nelson, manager of mines for the Republic Steel Corporation, Duluth, Minn., who was injured in an automobile accident a few weeks ago, is now well on the way to recovery.

Maurice Rey, professor of non-ferrous metallurgy at the University of Liége. Belgium, has returned to Liége after a three months' tour of inspection in the United States and Canada.

C. M. Bowyer is now superintendent in charge of Kemagama Gold Mines, Ltd., in Cadillac Township, Quebec. The property is under the management of Ventures, Ltd., and associates.

Allen Look recently left the United States Engineers, at Bonneville, Oregon, to become mine superintendent for the General Electric Company at Germania tungsten mine, at Fruitland, Wash.

R. A. Mackay, Inspector of Mines in Tanganyika Territory, who for the past eighteen months has been in charge of the Mines Division on Lupa Gold Fields, has gone to Johannesburg to supervise the mining exhibit of East African Territories at the Johannesburg Empire Exhibition.

L. C. Penhoel, of the Penhoel-Menardi Engineering Corporation, has returned to his headquarters in Los Angeles after a trip to British Columbia, where he examined the Silver Cup mine, near Nelson, operated by **E. R. K. Waite.**

A. T. Thomson, who has been connected with Phelps Dodge Corporation since 1896 and has filled the office of secretary and treasurer, has resigned, effective Jan. 1, 1937, because of ill health. **James E. Fisher** has been made treasurer and assistant secretary and **George R. Drysdale** secretary and comptroller.

Nathan Amster has been elected to the presidency of the Granby Consolidated Mining, Smelting & Power Company, which is reported to be planning an investigation into the feasibility of reopening the company's Allenby properties, in British Columbia.

E. P. Sawyer has resigned his position as manager of the Athona Mines, operating in the Lake Athabasca region of northwestern Canada, and has accepted a post in a similar capacity with the Alcona Mines, Ltd., Alcona, Ontario.

Edwin Lang Miller has been reelected president of Wright-Hargreaves Mines, Ltd., and **William H. Wright,** vice-president; **Philip H. Gerhard,** secretary; **Gerard F. Miller,** treasurer; and **M. L. Boyer,** assistant secretary and assistant treasurer, have also been continued in their respective offices.

L. H. Timmins has been elected president of the Chromium Mining & Smelting Corporation, succeeding **A. R. Globe. Prof. W. G. McBride** has been appointed consulting engineer at the company's mine at Collins, Ont., and **M. J. Udy** has assumed charge of the plant at Sault Ste. Marie.

William H. Munds has been transferred to the Pine Creek tungsten property, near Bishop, Calif., of the United States Vanadium Corporation, from the company's property at Naturita, Colo. He will become superintendent at the Pine Creek plant.

Allan J. Anderson, formerly mine manager for Central Patricia Gold Mines, has been appointed consulting engineer for Brengold Mines, which has a property in the Sturgeon River area, in northern Ontario, Canada.

William B. Payton, formerly with the Hudson Bay Mining & Smelting Company at Flin Flon, Manitoba, is now on the mines inspection staff of the Mines Branch, Department of Mines and Natural Resources, Winnipeg.

George F. Seager, professor of geology on the staff of Texas College of Mines and Metallurgy, at El Paso, is now in the same department of the Montana School of Mines at Butte, Mont.

Howard I. Young, president of American Zinc Institute, is ex-officio member of the "Galvanizers Committee," a new permanent organization allying the technical groups of the steel and zinc industries, as is also **E. V. Gent,** secretary of the Institute, who was elected secretary-treasurer of the new group.

Fred Jones, for many years superintendent of the Portland mine, Cripple Creek, Colo., has returned to Cripple Creek and taken charge of the Detroit-Cripple Creek Company, working both the American Star and the Rigi mines.

J. M. Forbes has been engaged as consulting engineer by Pandora-Cadillac Gold Mines, Ltd., and will direct the operations at the company's property in northern Quebec. **R. W. Howe** has been appointed consultant to the General Engineering Company, Ltd. (Canadian), and will give particular attention to mining development in Ontario and Quebec.

John Dugan has been appointed general superintendent of mines for the International Smelting & Refining Company. He will be in charge of all the mining operations of the company in Utah, Nevada, and California. Mr. Dugan had been with Anaconda for 30 years pervious to assuming his new post. He will make his headquarters in Salt Lake City, Utah.

Arthur Newell Talbot, professor emeritus of engineering in the University of Illinois, has been awarded the 1937 John Fritz Gold Medal, highest of American engineering honors. Professor Talbot, who is 79, was cited as "moulder of men, eminent consultant on engineering projects, leader of research, and outstanding educator in civil engineering."

R. J. Parker has been elected a director of Roan Antelope Copper Mines, Ltd., and Rhodesian Selection Trust, Ltd. It was on his reports, as examining engineer, that the Roan Antelope and the Mufulira properties were drilled to test the ore deposits below the long previously abandoned openings, and he supervised the work on both properties till their value was definitely established.

Felix Wormser, secretary of Lead Industries, Inc., has returned from Mexico City, where he attended a convention of the American Institute of Mining and Metallurgical Engineers. It was the first time that this organization has held a convention in Mexico and about 250 American engineers attended.

G. A. Harcourt, who was employed during last summer by the Ontario Department of Mines to prepare a geological map and report of the Schreiber mining area of Ontario, returned to Harvard University at the end of the season to conduct postgraduate work in spectrographic and X-ray research dealing with ore minerals. He is also assisting Prof. L. C. Graton with his University work.

Cornelius F. Kelley, president of the Anaconda Copper Mining Company, has accepted appointment as chairman of the committee of members of the non-ferrous metals industry which will participate in the campaign to sell $27,829,500 of debenture bonds to finance construction of the New York World's Fair, according to an announcement by Richard Whitney, chairman of the World's Fair Bond Sales Committee.

Merle H. Guise, mining engineer from Fairbanks, Alaska, has come "outside" for the winter and is dividing his time between California and New York City. He reports that the large washing plant and dragline which he installed on Peters Creek, just south of Mount McKinley, last spring, closed a successful season in September. He is staying while in New York at the Taft Hotel.

OBITUARY

Thomas J. Flynn, long prominent in the mining circles of Colorado and northern Ontario as a pioneer and manager of mines, and known throughout the North as "Uncle Tom," died in Toronto on Nov. 8.

Dwight T. Smith, prominent California and Nevada geologist and rancher, died recently at Reno, Nev. Smith was a son of Timothy B. Smith, pioneer California and Nevada miner and one-time partner of Philip Armour, Sr. He was graduated from the University of California School of Mining in 1900. For some years he was a member of the United States Geological Survey. Later he became State Director of the School of Mines of Nevada.

E. B. Kimball, mining engineer, died at Georgetown, British Guiana, on Nov. 18. Mr. Kimball was a graduate of Stanford University (1895) and had had extensive experience in the practice of his profession in the Western areas of the United States, Canada, Alaska, Mexico, Colombia, the Philippines, and the Malay States. At the time of his death he was associated with James D. Dole and L. A. Glover in examining properties in British Guiana for Selected Dredging Investments, Ltd.

George E. Murray, assistant general superintendent of the Consolidated Mining & Smelting Company of Canada, Ltd., died suddenly Nov. 8 after being stricken by cerebral hemorrhage during a staff luncheon at Tadanac, British Columbia. His contributions to the field of metallurgy during his twenty-six years' service with the company were noteworthy, and in 1933 he was awarded the Randolph Bruce Medal of the Canadian Institute of Mining and Metallurgy for outstanding research in the development of the slag fuming process. He was born at Amherst, Nova Scotia, in 1889, and was a graduate of McGill University, obtaining the bachelors' degree in science in 1911 and the masters' degree the following year.

Major General the Hon. Sir Newton James Moore, long associated with the gold-mining industry of West Australia, and Premier of that State in 1906, and more recently identified with Canadian and Australian mining corporations, is reported from Australia to have died there recently.

John Frelinghuysen Harman, "Dean of the Silver Industry," of the internationally known firm of Handy & Harman, died on Nov. 25 at the age of 92. He had been active in the affairs of the company for 64 years. Mr. Harman was born in 1844 in the Shenandoah Valley of Virginia, his ancestors being of pre-Revolutionary stock, and was graduated from Washington and Jefferson College in 1865, after which event he came to New York to take a position with the specie firm of his uncle, Jacob Stoll Conise. Soon thereafter he entered the employ of Peter Hayden, dealer in bullion, and acquisition of that business by Parker Handy marked the beginning of Mr. Harman's association with three generations of the Handy family. Handy & Harman is best known throughout the world for its daily price for silver in New York, which is known as "New York Official." Mr. Harman retired from active business on his 87th birthday, May 1, 1931, but continued to act as a director on the board of the company until his death.

JOHN F. HARMAN

A LETTER . . . "The Bubble Machine For Flotation Testing"

The Editor:

We have read with interest the article (*E.&M.J.*, Vol. 137, p. 291, 1936) in which G. R. M. del Giudice, of the Mineral Dressing Laboratories of Columbia University, described the construction of the Columbia bubble apparatus and the technique of its use for flotation testing. As might be expected, when the later stages of the technique have been developed independently in two laboratories, differences have arisen in some of the details. Comments on some of these differences and a description of our alternative methods may be of value to others who may use the apparatus for flotation testing.

To facilitate the measurement of contact angle, we have illuminated the surface of the mineral obliquely. The image of the bubble on the screen then appears in juxtaposition with a reflection of the bubble in the surface of the mineral, and the exact position of this surface is thus defined. Experiencing difficulty with this method, del Giudice has kept the source of light on the same level as the specimen but has tilted the camera. Either method gives a well-defined image of the contact angle, and permits its estimation to within a degree or two. However, with a tilted camera the measured angle is smaller than the true contact angle. The error is small: the projection of an angle in a plant inclined at an angle of 10 deg. to the plane of the original angle may be smaller by ½ deg. than the original angle, but if the inclination is increased the error increases rapidly.

An electric lamp of the short coiled filament type (for example, a 12-volt 50-watt automobile headlamp) is a more convenient source of light than an arc. A ground-glass plate close to the lamp is used to produce a wide, uniform beam; the nearer it is placed to the lamp the brighter is the illumination. Intensity of illumination may be further increased by oiling the ground surface. This arrangement also improves the definition of the image of the reflection of the bubble. It is not improbable that del Giudice's failure to obtain the benefit of oblique illumination was due to our not having previously mentioned the use of this ground-glass screen. In this laboratory the condenser used has a focal length of 9 cm. and an aperture of 5 cm.; the distance between the lamp and the test cell is 30 cm.; the axis of the illuminating beam is inclined 4.5 deg. to the horizontal plane, and the photographic lens used is a Bausch & Lomb 32 mm. Micro Tessar. For the bubble holder we use simply a glass tube of 2.5-mm. internal diameter, to the upper end of which is attached a rubber tube closed by a spring clip. This holder is attached to the mechanical stage by spring clips. The bubble is formed at the submerged lower end of the holder by squeezing the rubber tube and then closing the spring clip. A mechanical stage is also used to support the glass cell. This stage has movement in three directions.

The remainder of our comments concern the method of obtaining uncontaminated polished mineral surfaces in a condition suitable for testing. We are in complete agreement with del Giudice's insistence that "The most important factor in the successful preparation of a specimen for testing in the bubble machine is cleanliness." The work of the Columbia investigators confirms our own experience that clean surfaces of all common minerals give a contact angle of 0 deg. in distilled water. Polished metal surfaces, when perfectly clean, likewise give contact angles of 0 deg. in distilled water. Failure to realize these facts has rendered useless a considerable amount of experimental work recently carried out in other laboratories.

Whether the use of "Duco" cement and bakelite cells is advisable is questionable. Although we have had no experience with this type of cell, it appears to us that there is a risk of contaminating the mineral surfaces with compounds dissolved from the bakelite or the cement, particularly when alkaline solutions are used. Such contamination may not result in the development of a contact angle, but may prevent or retard the adsorption of collectors. The cells used in this laboratory are described by the Hellige Company as being constructed of polished plate glass, vitrified at 600 deg. in a muffle furnace, acid-proof. However, the chromic acid used for cleaning the cells slowly attacks the joints, and strains are set up in the sides, which eventually fracture along the edges. The average life of a cell in continual use is about six months.

Although magnesium oxide is an excellent abrasive for polishing hard minerals for microscopic examination, its alkaline nature renders it unsuitable for some classes of flotation testing. It is difficult to remove all the fine abrasive from the sides of the polished specimen or from crevices in the polished surface; consequently, the pH value of a solution containing a specimen polished with magnesium oxide usually rises slowly as fine particles of the abrasive dissolve. It is therefore impossible to keep the solution at the desired pH value, and the test may be rendered useless. Treatment of the specimen with N/500 HCl prior to the test overcomes this difficulty, but it has not been established that the specimen is then in the same condition as a specimen polished with a neutral abrasive. We have therefore used only the abrasive emery, carborundum, and alumina.

It is advisable to use only glass laps for grinding and for polishing, whatever the mineral may be. For the polishing stages we use linen stretched over plate glass, separate laps being used for each mineral, so that accidental activation of any mineral by metal salts is impossible. The linen used is cleaned by boiling for several hours under reflux with an organic solvent such as acetone or alcohol, and then boiling in three lots of N/10 NaOH over a period of several days, followed by boiling in several changes of distilled water. This procedure removes the oil and grease introduced during the weaving process.

We have found that filter paper cannot be relied upon to be free from grease; consequently, we remove traces of abrasive and mineral slime from the polished surfaces of the mineral specimens by wiping them with a piece of cleaned linen tied with cotton thread over the end of a glass rod that has been flattened to give a surface about 7 mm. in diameter. To insure that the wipers are clean they are boiled for several hours first in N/10 NaOH and then in several changes of distilled water. A new linen covering is used for each specimen.

For handling the specimens we have used glass forceps. These can be made easily and cheaply by flattening one end of each of two equal lengths of 7-mm. glass rod and hinging the other ends with a short piece of rubber tubing. These forceps, cleaned in chromic acid, are conveniently kept in distilled water. Before transferring a polished specimen from one vessel to another, it is turned upside down. The water then drains on to the polished surface, which therefore has no opportunity of becoming contaminated by contact with the atmosphere.

A. B. Cox.
I. W. Wark.

Department of Chemistry,
University of Melbourne.
Sept. 10, 1936

NEW BOOKS

Up-to-date Cyanide Practice

CYANIDATION AND CONCENTRATION OF GOLD AND SILVER ORES. *By John V. N. Dorr. McGraw-Hill Book Company, New York. Pp. 480. Illustrations 130. Price $5.*

At least fifteen years have elapsed since the then latest book on cyanidation was published. Other standard works on the subject bear still earlier dates of issue. This hiatus in book literature on so important a process cannot be attributed to diminishing use; nor is it to be construed as indicating a static condition in the art. A more probable and logical explanation is that, in the interim, progressive improvement of cyanide practice throughout the world and details of new applications have been recorded in current literature, amplifying the basic information already published in book form.

In any event the time is ripe for a new book on the subject, and Mr. Dorr's work should be a welcome addition to the engineer's technical library. Metallurgists of the older as well as of the younger generation will be glad to find within the covers of a single book a summary of world-wide practice brought up to date. The author's high standing in the engineering profession and in the mining industry have not only given him exceptional access to sources of information, but they also lend authority to a painstaking piece of work.

Following an introductory historical chapter, the author discusses the examination and testing of ores. The outline of procedure is adequate for those who are qualified by training and experience to conduct their own tests. Preparation of ore for cyanidation is covered in four chapters on coarse crushing, sorting, fine grinding, and classification. Sand and slime treatment are given extensive consideration, including description of types of equipment and examples of practice. Other chapters are devoted to cyanidation of gravity and flotation concentrates, bullion recovery, and plant control.

Of special interest is the chapter on the treatment of simple and complex ores, in which details of practice are given for about 50 mills in all parts of the world handling a variety of ores. Attention is given to ores containing arsenopyrite, copper, pyrrhotite, tellurides, and base metals, as well as to simple ores of gold and silver. The treatment of old residues is covered in a separate chapter. Costs and power consumption are given for a large number of mills in different parts of the world. The final chapter contains reference information and data. Numerous flowsheets and illustrations give added value to the text.

Two factors combine to make Mr. Dorr's book an exceptionally complete treatise on the subject: First, his personal experience in, and his contributions to, the art of cyanidation, and second, his world-wide acquaintance with metallurgists who have cordially cooperated with him. The book should be recognized as the standard work on cyanidation for some time to come.

PUBLICATIONS RECEIVED

Ringelmann Smoke Chart. By Rudolph Kudlich. Information Circular 6888. U. S. Bureau of Mines, Washington, D. C. Pp. 3.

Design and Operation of a Four-ton-per-Hour Gold and Silver Ore-Sampling Plant. By E. D. Gardner and W. A. Leddell. Information Circular 6891. U. S. Bureau of Mines, Washington, D. C. Pp. 40.

Mineral Production of Canada, 1934. Annual Report, Dominion Bureau of Statistics, Ottawa, Que. Pp. 302.

Zinn (Tin). Changes in the production and uses of tin after the World War. By Dr. Josèf Wollnik. Published by Bibliographisches Institut A. G., Leipzig, Germany. Price 10 Rm. Pp. 224.

Silber. Heft 5, Wandlungen in der Weltwirtshaft. Bibliographisches Institut A. G., Leipzig, Germany. Price 7.50 Rm. Pp. 176.

Steinkohle. Heft 4, Wandlungen in der Weltwirtschaft. Bibliographisches Institut A. G. Leipzig, Germany. Price 6.50 Rm. Pp. 155.

A Guide for Prospectors in Manitoba. Published by the Director of Mines, Department of Mines and Natural Resources, Winnipeg, Manitoba. Pp. 109.

Gold Deposits of the Virginia Piedmont, Preliminary Report. By C. F. Park, Jr., Bulletin 44. Virginia Geological Survey, University, Va. Pp. 42.

Zinc and Lead Region of Southwestern Virginia. By L. W. Currier. Bulletin 43. Virginia Geological Survey, University, Va. Pp. 122.

Shifts in Sources of Chromite Supply. By Robert H. Ridgway. Information Circular 6886. U. S. Bureau of Mines, Washington, D. C. Pp. 11.

Tungsten Mineralization at Silver Dyke, Nevada. By Paul F. Kerr, University of Nevada Bulletin, Vol. XXX, No. 5. Reno, Nev. Pp. 70. Price 40c.

Gold Mining Industry in Canada, 1935. A Summary Review. Dominion Bureau of Statistics, Ottawa, Ont. Pp. 62.

Aviation. Junkers-Ratgeber (Junkers Adviser). Issued by Junkers Flugzeug- und Motorenwerke A.G., Dessau, Germany. Pp. 147. Price, Rm. 1.50.

Kavirondo, Kenya Colony. Geological Survey of No. 2 Mining Area. By C. Stansfield Hitchen. Pp. 26.

Quantitative Analyse. By Dr. Otto Brunck. Bergakademie Freiberg. Theodore Steinkopff, Dresden, Germany. Pp. 224. Illustrations 8. Price Rm. 9. A textbook on quantitative analysis.

Erzeugung von Eisen und Stahl. By Prof. Dr.-Ing. Robert Durrer, Technische Hochschule, Berlin. Theodor Steinkopff, Dresden, Germany. Pp. 159. Illustrations 78. Price Rm. 11. A bulletin on technical progress in the production of iron and steel.

La Geologie et les Mines des Vieilles Plateformes. By F. Blondel. A publication of the Bureau d'Etudés Gelogiques et Minières Coloniales, Paris, France. Printed by Société d'Editions Geographiques, Maritimes et Coloniales, 17, rue Jacob, Paris.

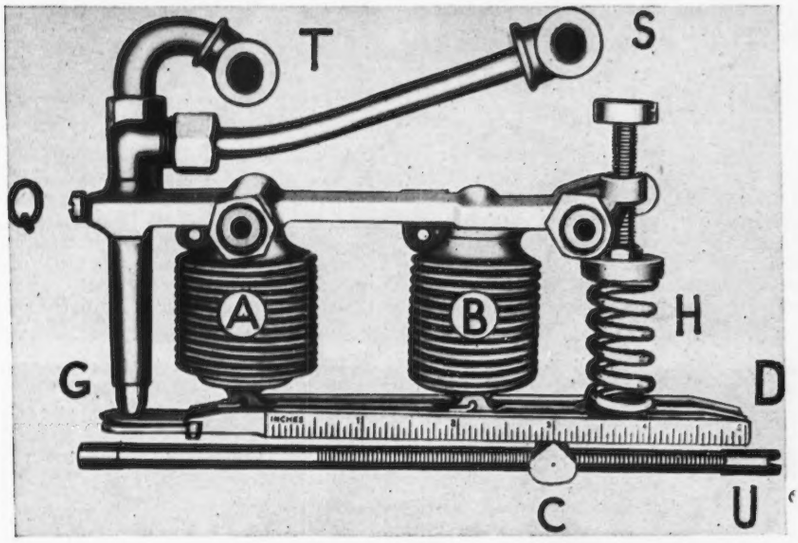
Applied Geology. Vols. I and II of the papers presented in the Section of Applied Geology of the Seventh International Congress of Mines, Metallurgy, and Applied Geology held at Paris, October 20-26, 1935. Printed in French. Vol. I, pages 1 to 528, inclusive. Vol. II, pages 529 to 1088.

Silicosis. Review of Literature on Effects of Breathing Dusts, With Special Reference to Silicosis. Part III-B, this being Chapter 5, "Economic and Legal Aspects of Dust Disease in Industry." By D. Harrington and Sara J. Davenport. Information Circular 6892, U. S. Bureau of Mines, Washington, D. C. Pp. 267-333, inclusive.

British Guiana Geological Survey Reports, including "Geology and Gold Deposits of the Konawaruk," by S. Bracewell (price 12c.); "Geology and Gold Deposits of the Potaro," by G. J. Williams, with a petrological appendix by D. R. Grantham (price 72c.); and "General Geology (1934) of the Mazaruni, Kuribrong, Konawaruk, Muruwa, Siparuni, Appararu, Puruni, and Rupununi." Price $3. Prices specified are in local currency. Georgetown, Demerara.

Bergtechnisches Taschenwörterbuch. A pocket dictionary of technical mining terms in two parts: English-German and German-English, pp. 90 and 76 respectively. The authors are Prof. W. Schulz, of Clausthal, Germany; Dr. Henry Louis, of Newcastle-on-Tyne, England; and Bergassessor E. Goethe, of Essen, Germany. They have taken pains to create a handy pocket dictionary giving the exact equivalents in the two languages of mining terms and phrases and expressions in related branches of science. Price, in Great Britain and the United States, Rm. 5.40. Published by Verlag Glückhauf G.m.b.H, Essen, Germany.

EQUIPMENT NEWS

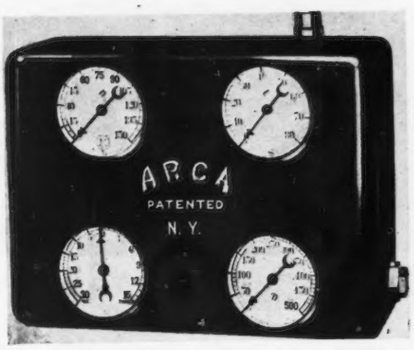


MULTI-PURPOSE AUTOMATIC CONTROL UNIT

The Arca Regulators, Inc., of 51 Locust Ave., Bloomfield, N. J., announce a new control unit belonging to the fluid relay class of automatic controls, wherein air, water, or oil is employed individually, or wherein they are employed together, to achieve a range of applicability said to be beyond that associated with the fluid class.

The unit illustrated with and without cover is said to be applicable to extremely close regulation for both high and low pressures; to maintain levels, providing fluid head acts as pressure; to determine r.p.m. by pressure as fan or pump is being driven from shaft; to temperature control, in which the bellows attached to the temperature element acts as a pressure impulse; to a complete range of vacuums; and to flows to be determined by using a differential over an orifice. The upper-left-hand gage indicates the air pressure as supplied from the air mains at a plant, and the gage is said to be used for any control application; the upper right indicates the reduced air pressure after passing the controllable needle valve "Q"; the lower left gage is a compound one; and the lower right indicates the reduced steam pressure as obtained by the use of this instrument as a pressure control. The upper gages are fitted to "T" and "S" in the cut showing mechanism and the lower ones are on a line which connects to bellows "A" and "B."

The principle of this new unit is said to be a fulcrum point upon which a lever member turns and the lever (D) tends to take a position of balance between the forces acting. The threaded shaft "U" is turned by a suitable tool (through an opening in the case) and when turned clockwise propels the fulcrum "C" to the right and counterclockwise to the left. The lever "D" is 5 in. long and is divided into 1/16 in. If a pressure control



is desired, the fulcrum "C" is placed between bellows "B" and spring "H," the higher the pressure impulse acting in "B" the nearer the fulcrum to "B." For vacuum determination the fulcrum would be placed to the right of spring "H" and all impulses are said to be connected to bellows "A," and bellows "B" would serve to compensate. For flow the fulcrum would be placed between bellows "A" and "B" where bellows "A" takes the higher impulse and "B" the lower impulse. At the end of lever "D" is a small flat spring which is said to move either to or from the air (or water) nozzle "G." The needle valve "Q" is used to throttle down to some desirable air pressure which would be indicated in the pressure gage connected to "S." The case is said to be gasketed and all working parts made of materials suitable for hydraulic as well as pneumatic systems. Cleansing pins in the nozzle tube "G" and in the passages to both bellows are said to automatically remove dirt particles. A choice of four springs in addition to the standard equipment is offered, as well as special bellows for unusual applications, and gage calibrated for any requirement. By selecting suitable gages, it is said one unit can be used successfully on a number of automatic-control applications such as in experimental departments or engineering laboratory. It is said this unit can be installed on some experimental or difficult control application and later altered in characteristics until a mode of control is found which the human operator cannot approach.

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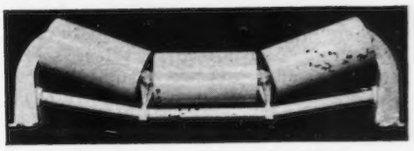
Truss Frame Belt Conveyor Carrier

A new "truss-frame," sealed ball bearing, belt conveyor carrier, built in sizes for 18 in. to 48 in. belts, that is said to be light, strong, and comparatively inexpensive; has recently been announced by Stephens-Adamson Mfg. Co. of Aurora, Ill. This carrier is of the three-roll in



line design, with outer rollers inclined to give the belt a 20 deg. trough. The whole roller assembly is tilted to center the belt without guide rollers, and particular effort has been made to produce a carrier that would minimize wear and tear on the conveyor belt. All parts are said to be made of steel and malleable iron. The rollers are built of 5-in. diameter steel tubing, with ends smoothly rounded over the pressed-steel end plates to prevent any tendency to fray the belt. Each bearing has been packed with grease and sealed at the factory and is said to be good for several years of operation before attention is necessary. The unique truss-type frame is said to be light and rigid, and the load is carried by a tension rod instead of depending upon the stiffness of a heavy cross member for support.

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Stoping Machine

The Gardner-Denver Company of Quincy, Ill., announces its new R–111 and R–91 self-rotated stopers, which, according to company officials, embody the latest and most advanced features of stoper design. Definite assurance of more footage per shift was the object sought in designing the new drills, the company states. To this end, the stoper is said to utilize proven-pawl rotation, effective check cleaning by exhaust air without reducing effective chuck length, and a tubular valve. Used on its drifting and sinking drills, the new stoper is said to have the ease of handling, economical operation, and freedom from maintenance expense. The R–91 stoper is a lighter drill for use where rock conditions are less severe, but is said to have the advantages of the R-111.

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Steam-Driven Compressor

Sullivan Machinery Company, of Michigan City, Ind., has developed a new single-gage, steam-driven horizontal compressor—Class WA–7—for steam pres-

sures 80 to 250 lb. air pressures up to 150 lb., and sizes 279 to 1987 c.f.m. WA-7 is said to be a heavy-duty, single-cylinder, double-acting unit for either air or gas compression. The steam cylinder is placed in tandem with the air cylinder next to the frame and is heavily lagged for steam economy. The steam valve is of the balanced piston type with inlet pressure in the middle, so that the valve rod box is sealed against exhaust pressure only. A variety of controls is said to be available to provide greatest economy under each operating condition: throttling fly-ball governor for steady steam and air pressure; fly-wheel governor for variable steam with steady air pressure, etc. Timken double-row main bearings, force-feed lubrication, special cast alloy air cylinder liner, and valves with laminated cushion backs are features which are said to add to efficiency.

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Dust Counter

For use in determining the degree of danger of dusty operations, Bausch & Lomb have developed and are offering to industry through Willson Products, Inc., Reading, Pa., an instrument which is said to simplify the problem of dust control. There is nothing to be set up where count is to be taken, as in the use of other available equipment, as the operator may enter the room, take the sample, and leave in less than fifteen seconds without interfering with routine or interrupting production. Requiring no skill to operate or technical supervision, daily or hourly

checks of dust conditions can be readily made. This new dust counter is said to combine in one unit the necessary air-sampling device and a dark-field microscope viewing and counting system. Suitably cased for transporting, the complete outfit is said to weigh 12½ lb.

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Light, Portable Core Drill

The E. J. Longyear Company, of Minneapolis, Minn., announces a new portable core drill known as the Pioneer Straitline. This is the lightest drill of the company's group and is said to weigh only 750 lb. complete. It can be "knocked down" for easy shipment by airplane or canoe and is operated by a standard gasoline motor developing 6.7 hp. at 1,600 r.p.m. Gasoline consumption is said to be 2½ to 5 gal. per 8-hr. shift. It is said to have a rated capacity of 600 ft. of core ⅝ in. in diameter. The rig is mounted on a sheet-steel frame and may be moved under its own power. A separate pumping unit is required for operation.

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Rubber Idlers

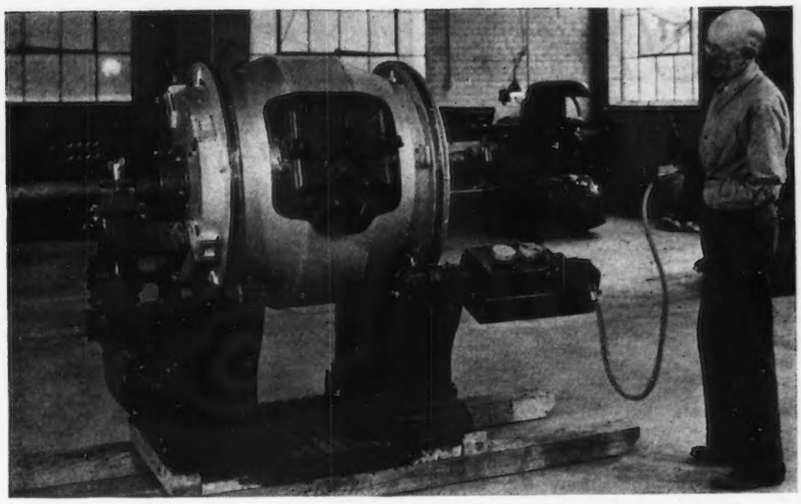
Mining operators using incline hoists have been confronted with the problem of frequent renewal of idlers which wear rapidly. Ordinarily, the idlers are made of wooden cylinders, although some have been made of metal. These require frequent renewal, which not only adds to the cost of the equipment but necessitates shutting down the incline during the renewal. A Los Angeles concern has developed an incline idler which is said to be made of tough resilient rubber of the same compound as used for drill-pipe protectors in oil-field service. The product is manufactured by Patterson-Ballagh Corporation, 900 East 65th St., Los Angeles, Calif.

ABRASIVES MASK

A mask has been developed for the prevention of silicosis by the Navy Department's safety engineer, W. P. Biggs. The mask is said to be a light-weight, comfortable unit, capable of giving complete protection to the wearer from the heavy concentrations of fine dust present in shot and sandblasting rooms, and is in use in the various Navy Yards and now in stock in the Navy Yard, New York, for issue to the Navy's industrial establishment. It is sturdily constructed and is said to be able to withstand the impact of high velocity abrasives. The protective efficiency and the durability of the mask have been thoroughly tested and proved by months of service on both shot and sandblasting work.

Air is fed into the facepiece through a corrugated rubber tube which permits free movement of the head. The incoming air enters the lower part of the facepiece and passes out through double exhalation valves, whose extremely low resistance to the air flow permits low pressure in the facepiece and assures an ample supply of air. A latex-covered silk hood which is low in weight, tough, and resilient to the high-velocity impact of the abrasive particles, fits neatly over the head and shoulders of the operator and fastens at his waist, exposing only the lens section of the facepiece. The air passing out of the exhalation valves from the mask serves to inflate the hood slightly, providing an air-cushion effect which increases the natural resistance of the fabric to the wearing action of the shot or sand. The hood is removable and replaceable, being attached to the facepiece with readily opened fasteners.

The mask has a flow control valve with a "bump-proof" adjustment. The setting cannot be changed accidentally, since the handle is normally held in a released or "free-wheeling" position by means of a spring which must be pushed in by the operator to an engaged position and then turned to change the flow of air. In the event the air supply should fail or become unusable, for any reason, a lever extending over the air-supply nipple of the flow-control valve immediately detaches the mask from the air line when pulled upward by the operator. This enables the operator to break his connection and breathe through the filter on the free end of the corrugated tube, and leave the confined space. If desired, a replaceable charcoal cartridge filter can be provided to remove objectionable odors and foreign matter such as dirt and oil from the incoming air, for the further protection of the operator.



ELECTRIC FURNACE

A new 350-lb. furnace, Type LFC, for high-temperature melting, is announced by Detroit Electric Furnace Company, of 825 West Elizabeth St., Detroit, Mich. It has been specially designed for melting copper, nickel, and alloy irons and steels. A major change from the Model LFA, which it replaces, is that the arc at the center of the furnace is farther away from the refractory than at the ends of the shell. The new shell is of larger diameter around the central portion than at the ends. A changed hearth design permits easier tapping and cleaning. The new furnace is said to be equipped with automatic rocking control and a remote pouring switch which can be operated at a distance from the unit. A magnetic brake motor is included as standard equipment on the rocking mechanism. The manufacturer believes that the improvements in the refractory and shell will result in longer refractory life, reduced power and electrode consumption, and a decrease in metal loss in the highly volatile alloys. The shell and refractory design are said to be such that the metal is constantly brought back to the hottest part of the furnace, being that part immediately adjacent to the arc, so that there is a constant action to provide a uniform temperature throughout the bath.

INDUSTRIAL NOTES

General Cable Corporation announces that **Howard E. Eagleston,** formerly Pacific district manager, has been appointed general sales manager, with headquarters at 420 Lexington Ave., New York City.

F. E. Feely, representative of **The International Nickel Company** in South America, and **J. S. Vanick,** a member of the development and research division, are visiting several South American countries to offer consultation service to industrial executives and engineers on problems involved in the production and application of nickel alloys. In early December they will visit Chile and may be reached at Casilla, 125D, the South American offices in Santiago.

J. F. Mitchell-Roberts, export manager for **Oliver United Filters, Inc.,** has returned from a six months' tour of the Far East, where he visited many plants using Oliver United filters in the Philippines, Japan, Manchukuo, and China. Among the operations most frequently surveyed were mining, sugar, pulp and paper, chemical, sewage treating, cement, and petroleum. Of particular interest were the Oliver continuous drum filters used for washing cyanide slimes and the American and Dorrco filters for dewatering concentrates. Mr. Roberts reports favorable progress in these countries in adopting modern methods of production and in making use of American-made equipment and American ideas.

Nordberg Manufacturing Company announces the appointment of **Harry Buckenheu,** sales engineer in the eastern territory, who will specialize in the sale of vibrating screens, also crushers, for this territory. **A. C. Colby,** manager of the crusher division of the company, of 60 East 42 St., New York City, will continue as the New York manager of the crusher and screen division.

The name of the Magnetic Manufacturing Company, 675 South 28th St., Milwaukee, Wis., has been changed to the **Stearns Magnetic Manufacturing Company,** according to an announcement from **R. H. Stearns,** president and general manager. The change does not involve any revision in corporate structure, management, or plant location, being simply an effort on the part of the company to identify its products more closely with its trademark name **Stearns.**

S. M. Hunter, formerly sales manager of the **Novo Engine Company,** is now affiliated with the sales department of the **American Hoist & Derrick Company,** Saint Paul, Minn.

BULLETINS

Theory and Practice of Mine Ventilation. A book measuring 5½x7¾ in., written by William J. Montgomery, a consulting engineer to the Jeffrey Manufacturing Co., Columbus, Ohio. The author draws upon 33 years of practical experience in the field of mine ventilation and in the design of fans for such purposes. There are 43 chapters, and the subject is presented in simple, understandable language and is not burdened with pages of algebra, trigonometry, calculus, and aerodynamic equations commonly found in the technical books dealing with this subject. Difficult equations have been purposely avoided so far as possible and simple formulas with arithmetical soutions have been used. The last two chapters, headed Engineering Data, and Special Notes, afford handy reference guides, explaining the various formulas and when and how applied. Numerous problems are given and worked out, and tables on air volumes, density and temperature, fan-speed ratios for different temperatures, and air resistance are included. The book is moderately illustrated. Pp. 285. Price $3.50.

Procedure Handbook of Arc Welding. The Lincoln Electric Company, Cleveland, Ohio, announces reissue of the "Procedure Handbook of Arc Welding Design and Practice," in enlarged form, containing 819 pages and 990 text illustrations. The handbook is reissued at this time to include all new data essential for efficient use of arc welding in all its varied applications. In size, the book is 5¾x9 in., a convenient form for desk or shop use. The binding is semi-flexible simulated leather, gold embossed. New data presented in the "Procedure Handbook" include complete information on the following subjects: Characteristics of the Welding Generator; Selection of Type of Joint; Insurance of Fusion Welded Vessels; Welding Codes; Arc Cutting; Polarity of Welding Current; Horizontal Welds; Sheet Metal Welding; Effect of Electrode Size on Welding Cost; Methods of Testing Weld Metals; 4-6 Chrome Steel; Monel Metal; Principles of Surfacing by Welding; Welded Design Begins With Standard Shapes and Plates; Plate Girders. In addition to containing the above data, the handbook has been thoroughly revised in all its departments in the light of present-day arc-welding practice. Copies will be mailed, post paid, to any address in the United States for $1.50 per copy. Outside United States, $2.

Steam Turbine Units. Allis-Chalmers Mnfg. Co., Milwaukee, Wis. Bulletin 1179 covers in detail the automatic extraction turbine frames for capacity range of 500 kw. through 5,000 kw. Pp. 36; Low Head Vibrating Screens, Bulletin 1478, contains tables of sizes, weights, and dimensions of screens. Pp. 8.

Portable Cable. General Cable Corp., 8 Church St., White Plains, N. Y. Bulletin SS 2 contains tables of various type cables and general cable information. Pp. 34.

Nickel Alloy Steels. International Nickel Co., New York, has published a 20-page buyers' guide to warehouse stocks of nickel-alloy steels in various parts of the United States and Canada.

Gold Precipitation. The Merrill Co., 343 Sansome St., San Francisco, Calif., has published a new catalog illustrating and describing the Merrill-Crowe simultaneous clarification-precipitation process for the recovery of gold and silver from cyanide solutions. Typical flowsheets are shown; also views of precipitation plants at the Randfontein in South Africa, and the Golden Queen, at Mojave, Calif., the former being the largest in the world. Copy sent on request.

Diesel Engine. Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin contains data on the improved design of manufacturers' Type S diesel engine. Pp. 24. Jackhamers Bulletin 2254 describes the JA-30, a new drill for light rock drilling. Pp. 4.

Rock-Bit Grinder. Mine & Smelter Supply Co., Denver, Colo. Folder describing heavy-duty grinder for detachable bits.

Denver Equipment Index. A catalog illustrating and describing products of the Denver Equipment Co., Denver, Colo. The book measures 8½ x 11 in. and contains articles of interest to engineers on flotation plants and their design, cyanide practice, small gold mills, auto truck milling plants, estimations on mill buildings; and amalgamation and flotation practice. Contains useful table and general engineering data. Pp. 160. Price $2.

Solenoid Starters. Allen-Bradley Co., Milwaukee, Wis. Bulletin 709 describes new type of starter. Pp. 4.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

PRICES for major non-ferrous metals advanced even more sharply during November than in the preceding month. The initiative in raising prices was taken by London operators. Improvement in world trade, rearmament, currency uncertainties, and a tense political situation on the Continent were market factors. Speculation in the London market increased in intensity, which development was disturbing to producers intent on maintaining an orderly price movement.

Consumption of copper, lead, and zinc throughout the world during November held close to the high level established in the preceding month. World stocks of refined copper at the end of October stood at 356,785 short tons, against 379,986 tons at the end of September. World stocks of lead and zinc are not released for publication. United States stocks of refined lead at the end of October amounted to 183,430 tons, against 200,517 tons a month previous and a high of 231,081 tons at the end of July. Domestic zinc holdings were reduced from 76,630 tons in September to 68,892 tons in October.

Sales of copper for the month of November in the domestic market totaled 88,178 tons, with the bulk of the business placed just as the price advanced to the 10½c., Valley. Consumers have sufficient copper on hand and contracted for to carry them over until next May, providing domestic demands do not increase. Copper brought a higher price abroad than here most of the month. Our November average on export copper, f.o.b. refinery, was 10.347c., against 10.161c. on domestic business. Foreign producers participating in the curtailment agreement raised their rate of operations to 105 per cent of the basic tonnages, effective Nov. 5.

Lead was advanced to 5.20c., New York, the highest price since Oct. 8, 1930. Demand was active.

Surplus stocks of zinc are being reduced abroad, and, with prices up in London, producers here responded by advancing the price to 5.05c., St. Louis.

The feature in tin was the announcement from official sources that an agreement has been reached on the terms on which Siam would become a party to renewal of tin control.

United States Market

1936 Nov.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
2	9.775	10.100	45.850	4.80	4.65	4.85
3	Holiday	10.200	Holiday	Holiday	Holiday	Holiday
4	9.775	10.325	47.500	4.90	4.75	4.85
5	9.775	10.375	49.500	5.00	4.85	4.85
6	9.775	10.425	50.900	5.00	4.85	4.85
7	9.775	10.475	50.625	5.00	4.85	4.85
9	10.275	10.500	53.500	5.00	4.85	4.85@4.95
10	10.275	10.450	53.750	5.10	4.95	4.95
11	Holiday	10.325	Holiday	Holiday	Holiday	Holiday
12	10.275	10.150	52.500	5.10	4.95	4.95
13	10.275	10.150	53.000	5.10	4.95	4.95
14	10.275	10.200	52.625	5.10	4.95	4.95
16	10.275	10.225	51.650	5.20	5.05	4.95
17	10.275	10.275	51.650	5.20	5.05	5.00@5.05
18	10.275	10.300	51.500	5.20	5.05	5.05
19	10.275	10.375	51.425	5.20	5.05	5.05
20	10.275	10.425	51.175	5.20	5.05	5.05
21	10.275	10.425	51.000	5.20	5.05	5.05
23	10.275	10.425	51.000	5.20	5.05	5.05
24	10.275	10.425	51.875	5.20	5.05	5.05
25	10.275	10.400	52.500	5.20	5.05	5.05
26	Holiday	10.425	Holiday	Holiday	Holiday	Holiday
27	10.275	10.450	52.600	5.20	5.05	5.05
28	10.275	10.450	52.500	5.20	5.05	5.05
30	10.275	10.450	52.000	5.20	5.05	5.05
Av. for month	10.161	10.349	51.392	5.114	4.964	4.974
Averages for Week						
Nov.						
4	9.775	10.092	46.355	4.82	4.67	4.850
11	9.975	10.425	51.655	5.02	4.87	4.880
18	10.275	10.217	52.154	5.15	5.00	4.979
25	10.275	10.413	51.496	5.20	5.05	5.050
Calendar Week Averages						
Nov.						
7	9.775	10.317	48.875	4.94	4.79	4.850
14	10.275	10.296	53.075	5.08	4.93	4.940
21	10.275	10.338	51.400	5.20	5.05	5.029
28	10.275	10.429	52.095	5.20	5.05	5.050

Silver, Gold, and Sterling Exchange New York and London

1936 Nov.	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
2	4.88875	4.88000	44.750	20.0000	142s 2½d	$35.00
3	Holiday	Holiday	Holiday	20.1250	142s 2 d	Holiday
4	4.88750	4.88000	44.750	20.2500	142s 2½d	35.00
5	4.88625	4.87750	44.750	20.3125	142s 3 d	35.00
6	4.87500	4.86625	44.750	20.5625	142s 6½d	35.00
7	4.87500	4.86625	(e)	20.8125	142s 7½d	35.00
9	4.87500	4.86625	47.500	21.8750	142s 8½d	35.00
10	4.87500	4.86750	47.500	22.9375	142s 7½d	35.00
11	Holiday	Holiday	Holiday	22.4375	142s 5½d	Holiday
12	4.87750	4.87000	45.500	20.8125	142s 6 d	35.00
13	4.87875	4.87125	45.500	21.0000	142s 7½d	35.00
14	4.89000	4.88375	(e)	21.3125	142s 4½d	35.00
16	4.88875	4.88125	45.500	21.0625	142s 3½d	35.00
17	4.88500	4.87750	45.500	21.2500	142s 4 d	35.00
18	4.88750	4.88000	45.500	21.1250	142s 3 d	35.00
19	4.89125	4.88375	45.250	21.0000	142s 2½d	35.00
20	4.88875	4.88250	45.125	21.0000	142s 2 d	35.00
21	4.89000	4.88500	(e)	21.1875	142s 2 d	35.00
23	4.89375	4.88750	45.375	21.1250	142s 2 d	35.00
24	4.89375	4.88750	45.125	20.9375	141s 10½d	35.00
25	4.89625	4.89000	45.125	21.0625	142s 1 d	35.00
26	Holiday	Holiday	Holiday	21.0000	141s 11½d	Holiday
27	4.89625	4.89125	45.125	21.0000	141s 11½d	35.00
28	4.89875	4.89375	(e)	21.0625	142s 0 d	35.00
30	4.90125	4.89625	45.125	21.0000	141s 11 d	35.00
Av. for month	4.88727	.....	45.431	21.050	.....	35.00
Averages for Week						
Nov.						
4	4.88775	.....	44.750	.....	.....	.....
11	4.87725	.....	46.125	.....	.....	.....
18	4.88458	.....	45.500	.....	.....	.....
25	4.89229	.....	45.200	.....	.....	.....

Calendar week averages: New York Silver, Nov. 7th, 44.750; 14th, 46.500; 21st, 45.375; 28th, 45.188.
(e) No quotation (Saturday).

The above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less then 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57. Handy & Harman's quotation for domestic silver, .999 fine, was 77c. per ounce throughout November.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

1936	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Standard					
Nov.	Spot	3M	Bid	Spot	3M	Spot	3M	Spot	3M
2	43.3750	43.6875	47.5000	208.0000	206.2500	19.3125	19.2500	15.8750	16.1875
3	43.5000	43.8125	48.0000	211.5000	209.8750	19.8750	19.8750	16.0625	16.3125
4	44.2500	44.5625	48.5000	217.0000	214.5000	20.2500	20.2500	16.2500	16.5625
5	44.1250	44.4375	48.7500	213.7500	210.5000	20.5625	20.5625	16.0625	16.3750
6	44.6875	45.0625	49.2500	235.5000	232.5000	21.3125	21.3125	16.4375	16.7500
9	44.3125	44.6875	49.5000	240.2500	238.0000	21.4375	21.4375	16.3125	16.6250
10	43.8750	44.3125	48.7500	244.5000	241.5000	21.1250	21.1250	16.3125	16.6250
11	43.5625	43.9375	48.5000	232.0000	228.7500	21.2500	21.3125	16.0625	16.3750
12	42.7500	43.1250	47.0000	235.7500	232.7500	20.8125	20.8125	15.4375	15.7500
13	43.2500	43.6250	47.5000	239.2500	236.0000	20.8750	20.8750	15.7500	16.0625
16	43.4375	43.8125	47.7500	234.5000	232.0000	20.7500	20.6875	15.8750	16.1250
17	43.6875	44.0625	48.0000	231.5000	230.7500	21.1250	21.0625	15.7500	16.0000
18	44.1250	44.5000	48.5000	234.2500	233.2500	21.8750	21.7500	16.1250	16.3750
19	44.5000	44.8750	48.8750	233.5000	232.7500	22.5000	22.4375	16.3750	16.6875
20	44.2500	44.6250	49.0625	232.7500	232.2500	22.8125	22.8125	16.6875	16.9375
23	44.5000	44.8750	48.8750	231.5000	231.0000	23.6875	23.5625	16.8750	17.1250
24	44.2500	44.6250	48.7500	232.7500	232.2500	23.4375	23.4375	16.9375	17.1250
25	43.8125	44.2500	48.5000	233.2500	233.0000	23.1875	23.1875	16.8750	17.0000
26	44.0625	44.4375	48.7500	236.0000	235.0000	23.2500	23.2500	16.6875	16.8125
27	44.1875	44.5625	48.7500	236.0000	235.0000	23.3125	23.2500	16.8125	16.9375
30	44.0625	44.3750	48.7500	234.7500	233.7500	23.4375	23.3125	16.7500	16.8750
Av. for month	43.932	.....	48.467	230.869	.....	21.723	21.693	16.301	16.554

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(December 1, 1936)

Miscellaneous Metals

Aluminum, ingot, 99 plus per cent, lb	19@21c.
Antimony, domestic, spot, lb	12.375c.
Bismuth, ton lots, lb	$1.00
Cadmium, lb	75c@$1.05
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (official quotation) troy oz	$48.00
Quicksilver, flask of 76 lb., 100 flasks or more	$88.50@$92.00
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$2.00
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75@$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.75@$17.00
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Old Range non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent Joplin, Mo., ton	$57.50@$59.72
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent	27c.
49@51 per cent	26c.
44@47 per cent	25c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$15.00
Domestic Scheelite	$15.50@$16.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime; 60 per cent concentrate, Joplin, Mo.; per ton	$32.50

Metallic Compounds

Arsenious Oxide (arsenic) lb	3½c.
Cobalt Oxide, 70@71 per cent, lb	$1.41@$1.51
Copper Sulphate, 100 lb	$4.15
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.34
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$30.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb	10c.
Ferromanganese, 78@82 per cent, gross ton	$75.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.30@$1.40

Non-Metallic Minerals

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$550@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$150
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47.50.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$5.50@ $7.00
French, 56@59 per cent	(a)$6.50@ 7.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$7.00@ $9.00
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$18.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	15@30c.
2 x 2 in	30@50c.
3 x 3 in	75@$1.00
3 x 4 in	$1.00@$1.25
4 x 6 in	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a)12@12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$21.00
Basic	$20.00
No. 2 Foundry	$20.50
Steel, base prices, Pittsburgh:	
Billets, gross ton	$32.00
Structural shapes, 100 lb	$1.90
Bars, 100 lb	$2.05

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1935	1936	1935	1936	1935	1936
January	54.418	47.250	24.584	20.250	489.207	496.115
February	54.602	44.750	24.818	19.796	487.278	499.908
March	59.048	44.750	27.380	19.663	477.635	496.952
April	67.788	44.892	30.986	20.245	483.596	494.139
May	74.356	44.869	33.865	20.248	488.587	496.850
June	71.940	44.750	32.346	19.770	493.245	501.817
July	68.216	44.750	30.500	19.590	495.558	502.178
August	66.366	44.750	29.476	19.490	496.815	502.519
September	65.375	44.750	29.255	19.579	492.917	503.455
October	65.375	44.750	29.368	19.977	490.577	489.755
November	65.375	45.431	29.284	21.050	492.277	488.727
December	58.420	.....	25.563	.....	492.715	.....
Year	64.273	.....	28.952	.....	490.034	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1935	1936	1935	1936	1935	1936	1935	1936
January	8.775	9.025	6.583	8.358	28.077	34.706	31.261	38.788
February	8.775	9.025	6.341	8.566	27.175	35.313	30.244	39.463
March	8.775	9.025	6.526	8.708	28.518	36.040	31.607	40.227
April	8.775	9.169	7.328	8.849	31.231	36.975	34.763	41.131
May	8.775	9.275	7.794	8.819	33.344	36.690	36.733	40.839
June	8.634	9.275	7.307	8.790	30.799	36.324	34.039	40.357
July	7.775	9.352	7.350	8.993	31.024	37.217	34.261	41.228
August	7.979	9.525	7.738	9.297	32.646	38.259	35.976	42.375
September	8.504	9.525	8.146	9.523	34.036	38.915	37.952	43.267
October	8.967	9.563	8.514	9.669	35.226	40.980	39.609	45.295
November	9.025	10.161	8.414	10.349	35.229	43.932	39.396	48.467
December	9.025	.....	8.414	.....	35.097	.....	39.313	.....
Year	8.649	.....	7.538	.....	31.867	.....	35.430	.....

New York quotations, cents per pound. London, pounds sterling per long ton (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1935	1936	1935	1936	1935 Spot	1935 3 Mos.	1936 Spot	1936 3 Mos
January	3.692	4.500	3.542	4.350	10.321	10.514	15.397	15.494
February	3.528	4.515	3.378	4.365	10.216	10.413	16.022	16.141
March	3.579	4.600	3.429	4.450	11.012	11.188	16.608	16.767
April	3.692	4.600	3.542	4.450	12.231	12.459	16.097	16.234
May	3.962	4.600	3.812	4.450	13.861	13.940	15.530	15.601
June	4.020	4.600	3.870	4.450	13.776	13.806	15.170	15.259
July	4.123	4.600	3.973	4.450	14.451	14.511	15.856	15.954
August	4.254	4.600	4.104	4.450	15.774	15.792	16.772	16.859
September	4.413	4.600	4.263	4.450	16.262	16.315	18.009	17.974
October	4.512	4.631	4.362	4.488	18.209	18.209	18.446	18.375
November	4.500	5.114	4.350	4.964	17.938	17.935	21.723	21.693
December	4.500	.....	4.350	.....	16.803	16.828	.....	.....
Year	4.065	.....	3.915	.....	14.238	14.326	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1935	1936	1935	1936
January	50.916	47.234	231.193	209.731
February	50.063	47.962	227.381	207.081
March	46.962	48.037	215.726	213.080
April	50.154	46.963	223.513	209.313
May	51.138	46.352	227.602	202.429
June	51.108	42.204	227.586	183.167
July	52.297	43.021	232.397	185.957
August	50.463	42.579	222.935	183.731
September	49.126	44.754	223.929	194.676
October	51.160	44.975	226.891	201.193
November	51.864	51.392	226.452	230.869
December	49.794	.....	220.075	.....
Year	50.420	.....	225.473	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1935	1936	1935 Spot	1935 3 Mos.	1936 Spot	1936 3 Mos
January	3.730	4.848	11.994	12.207	14.488	14.719
February	3.714	4.859	11.819	12.000	15.125	15.391
March	3.894	4.900	12.095	12.250	15.983	16.190
April	4.030	4.900	12.891	13.128	15.181	15.334
May	4.220	4.900	14.534	14.685	14.536	14.777
June	4.299	4.880	13.734	13.898	13.896	14.122
July	4.325	4.783	14.065	14.185	13.579	13.826
August	4.535	4.800	14.714	14.938	13.528	13.759
September	4.669	4.850	15.414	15.616	13.906	14.159
October	4.825	4.850	16.440	16.674	14.554	14.835
November	4.850	4.974	16.193	16.372	16.301	16.554
December	4.850	.....	15.091	15.278	.....	.....
Year	4.328	.....	14.082	14.269	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1935	1936	1935	1936
January	55.000	105.000	20.000	20.000
February	55.000	105.000	20.000	20.000
March	58.462	105.000	20.000	20.000
April	65.000	105.000	20.000	20.000
May	65.000	105.000	20.000	20.000
June	65.000	105.000	20.000	20.000
July	65.000	93.462	20.000	20.000
August	70.000	90.000	20.000	20.000
September	75.625	90.000	20.000	20.000
October	85.000	90.000	20.000	20.000
November	85.000	90.000	20.000	20.000
December	101.800	.....	20.000	.....
Year	70.491	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1935	1936	1935	1936	1935	1936
January	14.111	12.736	72.760	76.769	34.000	36.885
February	14.250	12.967	72.500	77.000	34.000	35.000
March	14.250	13.072	72.500	77.000	32.846	34.115
April	14.029	12.673	72.500	76.731	32.000	32.846
May	12.712	12.410	72.135	74.940	32.000	32.000
June	12.500	11.707	71.460	74.192	32.000	36.346
July	12.500	11.245	70.538	73.423	32.000	39.308
August	12.500	11.125	69.000	73.923	31.333	49.577
September	13.177	11.740	69.208	85.280	36.000	68.960
October	15.322	12.058	71.750	89.240	37.615	54.074
November	14.217	12.233	74.348	90.250	38.000	48.000
December	13.820	.....	75.200	.....	38.000	.....
Year	13.616	.....	71.992	.....	34.150	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

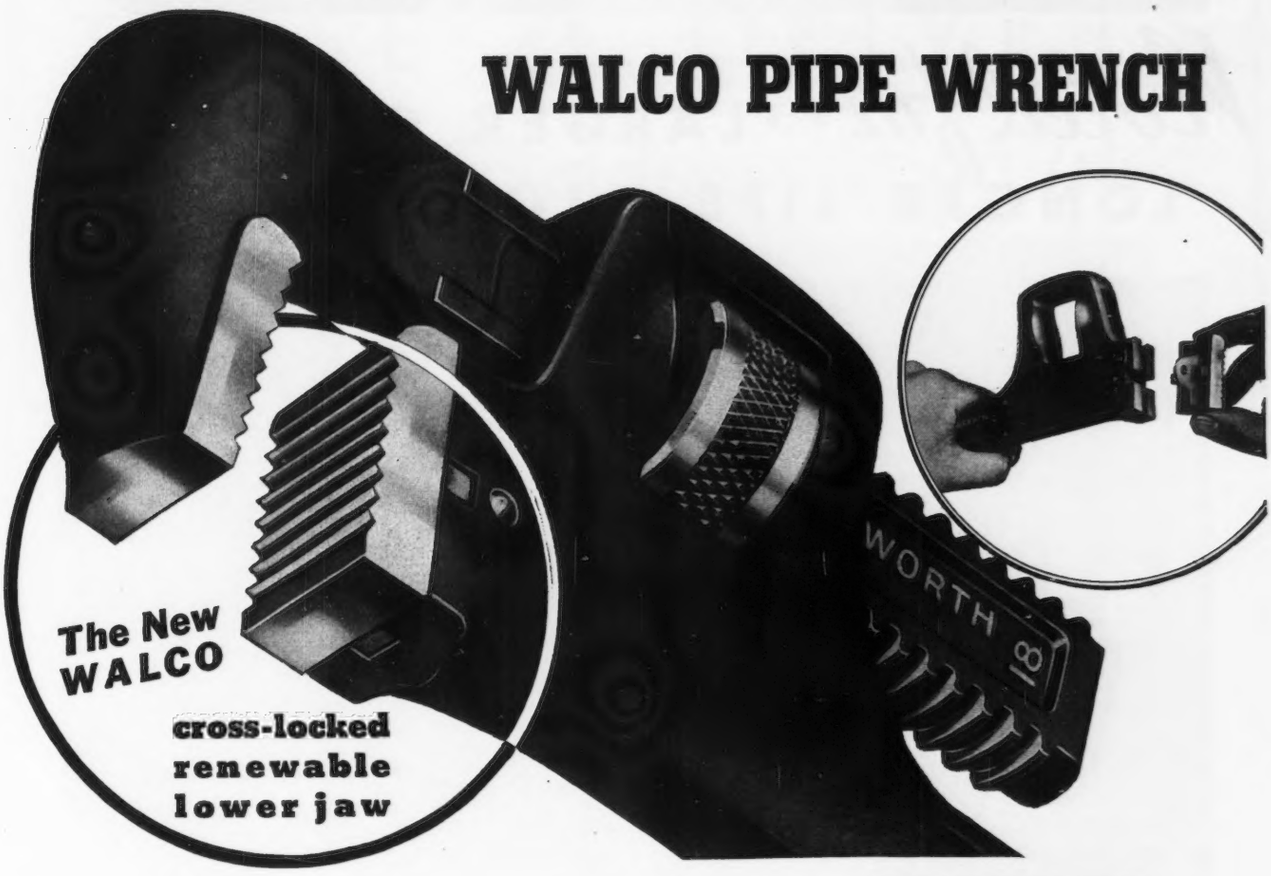
Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1935	1936	1935	1936	1935	1936
January	19.00	20.00	18.00	19.00	18.50	19.50
February	19.00	20.00	18.00	19.00	18.50	19.50
March	19.00	20.00	18.00	19.00	18.50	19.50
April	19.00	20.00	18.00	19.00	18.50	19.50
May	19.00	20.00	18.00	19.00	18.50	19.50
June	19.00	20.00	18.00	19.00	18.50	19.50
July	19.00	20.00	18.00	19.00	18.50	19.50
August	19.00	20.00	18.00	19.00	18.50	19.50
September	19.00	20.00	18.00	19.00	18.50	19.50
October	19.00	20.00	18.00	19.00	18.50	19.50
November	20.00	20.23	19.00	19.23	19.50	19.73
December	20.00	.....	19.00	.....	19.50	.....
Year	19.167	.....	18.167	.....	18.667	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

BUILT FOR LONG SERVICE...

WALCO PIPE WRENCH



The Walco Wrench is built for heavy duty. Its life is practically indefinite, for the part on which wear focuses—the teeth on the lower jaw—is renewable. New lower jaws, made of specially-hardened steel, can be inserted in place in a few minutes.

Safety is an inherent feature of Walco Wrenches. All parts are of drop-forged steel, with integral forged housings; all parts are heat-treated and Parkerized against rust. The renewable lower jaw cannot slip, and even severe abuse cannot spoil Walco's grip. No tools are necessary to replace the spring. Adjustment is easy—as the nut can be spun with the palm of the hand.

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This metallurgical microscope discloses and records the internal structure of metals, thus providing a check on the quality of product . . . in the forged state . . . after heat treatment . . . after subjection to service . . . or any simulated service condition.

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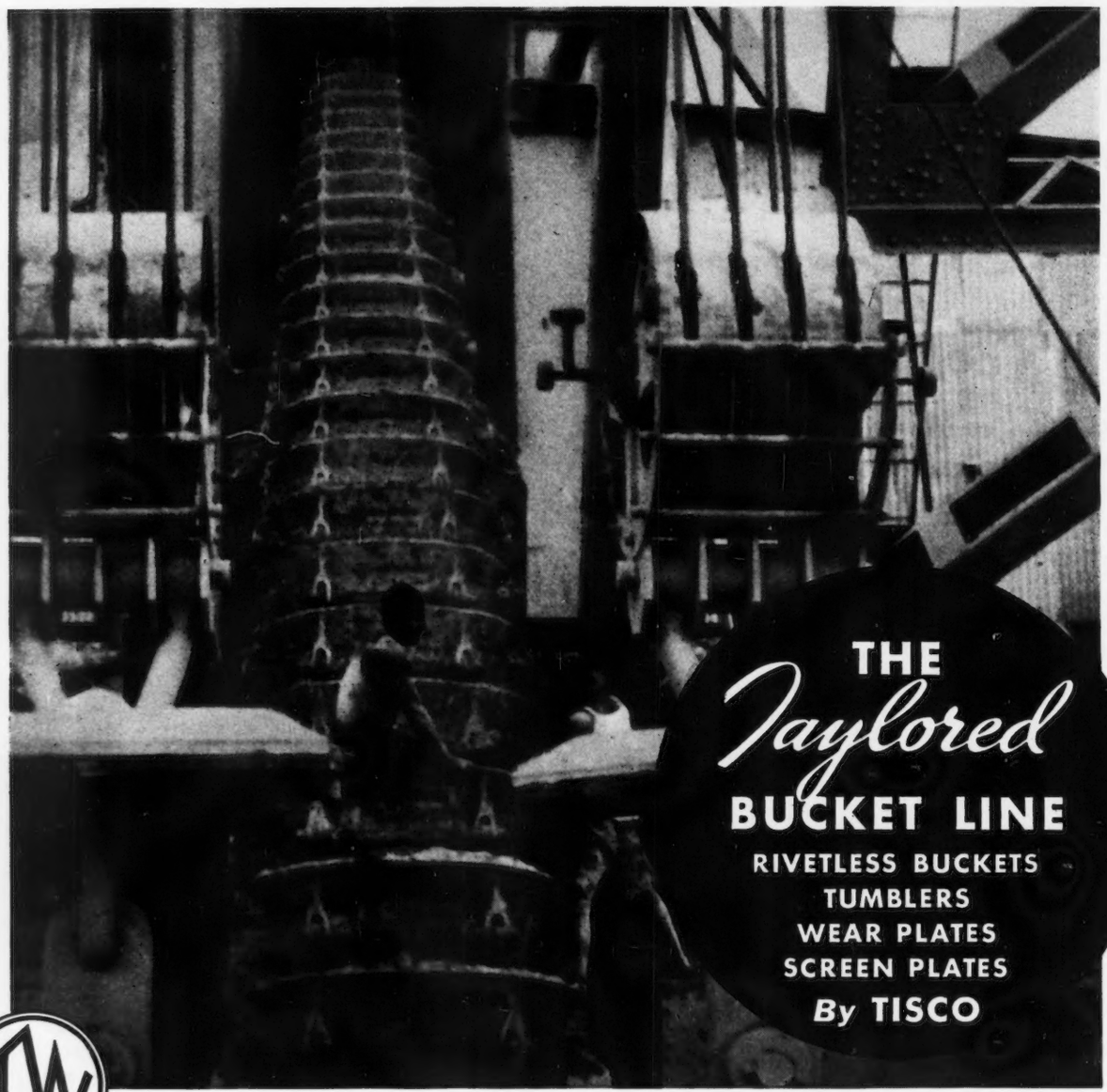

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THESE 4 OLIVERS

Prove the Soundness of an Idea

• The idea is low-submergence filtration.

• These four Olivers in the Omega Gold Mines Ltd. mill in Ontario are doing two different jobs: dewatering concentrates, filtering and washing repulped cyanided concentrate slimes in series. In each case, they proved that operating at high speeds through a shallow pulp bath improves capacities, washing and dewatering efficiency. Additional extractions are indicated, resulting from the longer aerating and washing zone.

• Every concentrator or cyanide mill, regardless of size, with high filtration costs or needing new filters should investigate this contribution to high capacity and low-cost milling by Oliver United. Bulletin 210 tells the story.

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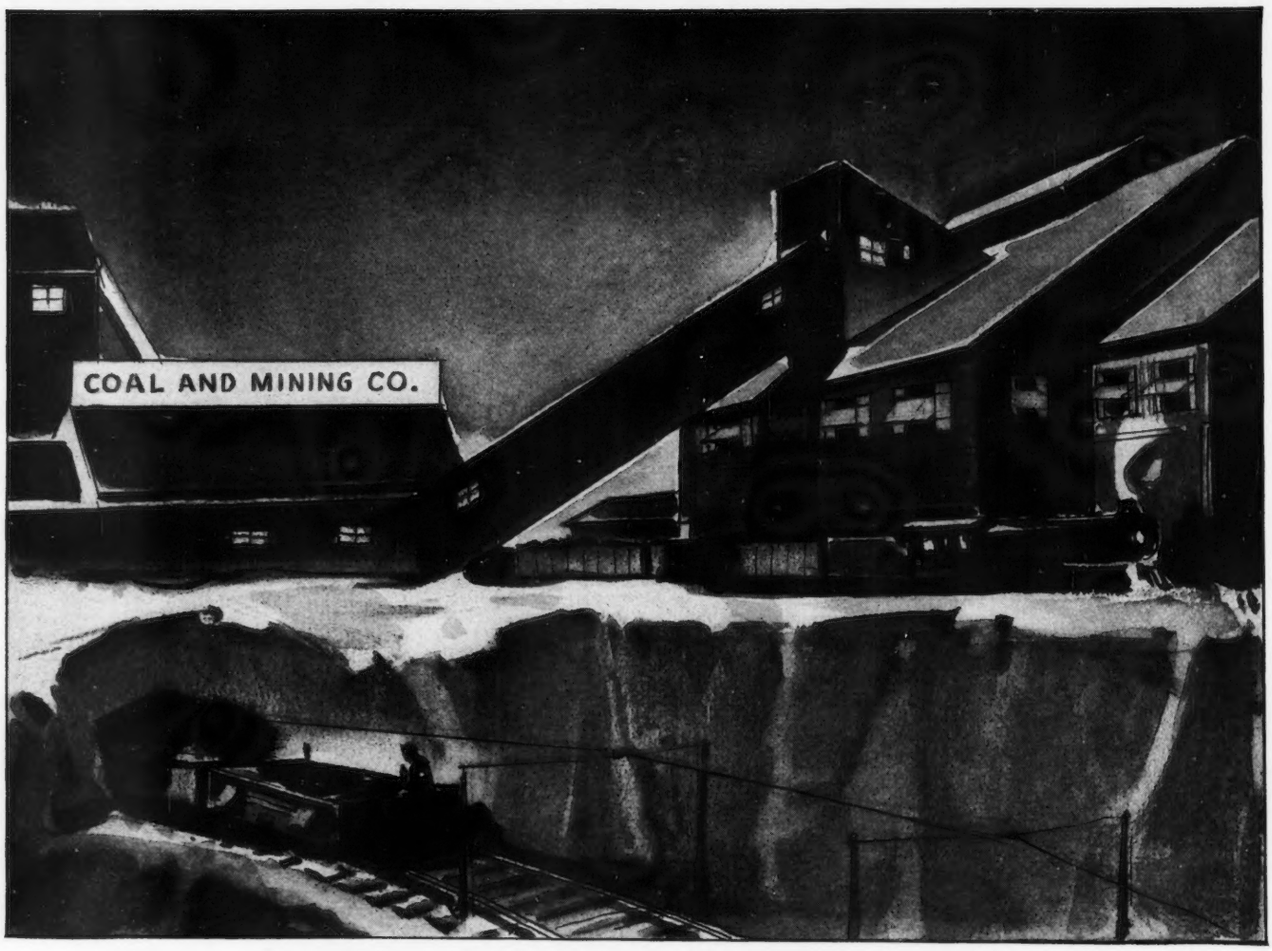
Where Treatment Is Rough . . . . Conditions Severe



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Mining engineers suffer no illusions about working conditions. They know that things move fast . . . and hard. There's no room for halfway measures. Equipment must be built to carry on in an environment of exacting production schedules.

Where competition imposes the most strenuous production, you will find Deltabeston Asbestos-insulated Wire and Cable. Men used to the stress and strain of mine operation, appreciate the exclusive features of these superior products.

Deltabeston Flexible Apparatus Cable is insulated with PURIFIED ASBESTOS. It offers greater insulation resistance and more dielectric strength. It will help you to maintain high output because of its greater resistance to moisture . . . and its longer life.

Deltabeston Magnet Wire, with its felted wall of PURIFIED ASBESTOS, will furnish added dependability to your mine motors. The combined use of these Deltabeston products . . . Apparatus Cable and Magnet Wire . . . will increase profits through sustained operation of your equipment.

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Adds the World's largest Magnetic Pulley to its Battery of Dings Magnetic Separators

ANOTHER Dings, of course—based on the excellent performance that Dings High Intensity Separators have always given this company.

This new pulley will weigh 20,000 lbs. and is specially wound to operate at 12,000 ft. above sea level. It will operate as the head drive pulley on a 54 in. belt handling 1,000 tons of ore an hour.

Over 35 years of experience has taught us "how"—how to build them correctly—how to save your money—how to solve special problems of all kinds involving trouble with iron, the removal of impurities and improving concentration.

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One of several Dings High Intensity Magnetic Separators in the plant of Climax Molybdenum Co. feeding a Nordberg Crusher.

SEPARATION HEADQUARTERS SINCE 1899

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SAVE

69% FLOOR AREA

41% EXPOSED SURFACE

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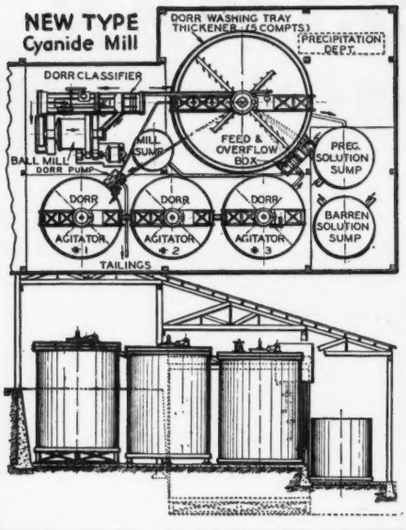
50-75% CONNECTED HORSEPOWER

WITH THE DORR WASHING THICKENER



ABOVE:	Total Floor Area	2,615 sq. ft.
	" Exposed Surface	12,367 sq. ft.
	" Building Volume	122,126 cu. ft.
BELOW:	Total Floor Area	8,439 sq. ft.
	" Exposed Surface	21,128 sq. ft.
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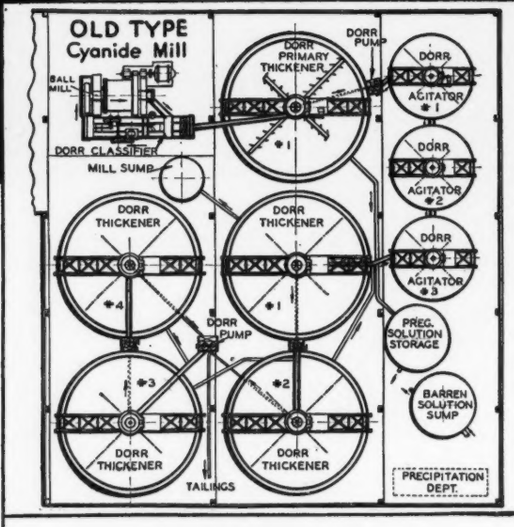

Counter Current Decantation in a single compact unit—that is the accomplishment of the Dorr Washing Tray Thickener.

Compare the new mill pictured at the top of the page with the old type illustrated below. A single, five compartment Dorr Washing Thickener in the modern plant is doing the job which formerly required five thickeners.

Savings in floor area, exposed surface area and building volume are self evident. Let these be translated into construction, operating and maintenance savings in your own mill.

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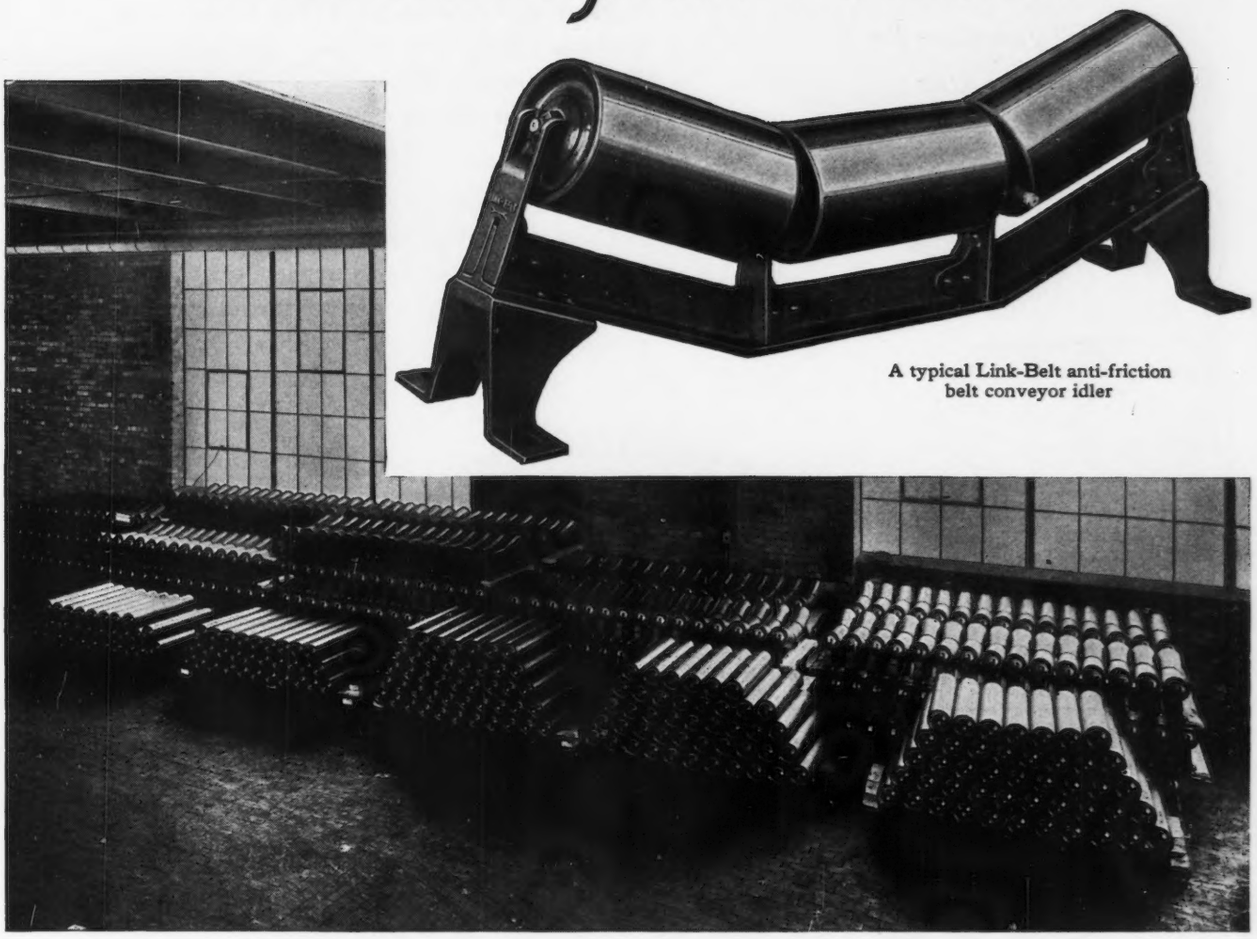

A typical Link-Belt anti-friction belt conveyor idler

● Three recent orders from two large nickel mining operations in northern Ontario included a total of approximately 2,000 sets of Link-Belt anti-friction belt conveyor idlers. The illustration shows a pile of 457 sets of these idlers ready for shipping . . . Link-Belt anti-friction belt conveyor idler service has made Link-Belt idlers extremely popular throughout the mining industry . . . They save power, lubrication and maintenance costs, and give long life in severe service. Ask us to send you literature and tell you more about them.

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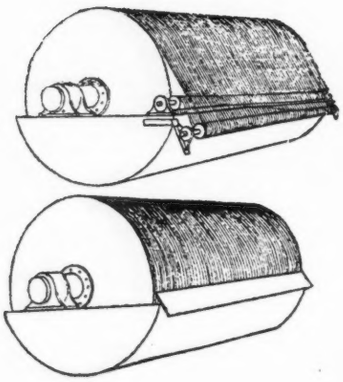
The *Right Type* of Filter *for* the Type of *Plant Process*

Either Type Can Be a FEinc Filter



In cyanide plants, FEinc Continuous Vacuum Filters with "String Discharge" are demonstrating the advantages of this type of discharge in those type of plants.

In handling concentrates, FEinc Continuous Vacuum Filters with Scraper Discharge are likewise showing the merits of the Scraper Discharge in the process of those type of plants.

Filtration Engineers, Inc. make both types of Continuous Vacuum Filters. They know the advantages of both types. Put your problem up to them. Convincing data is available.

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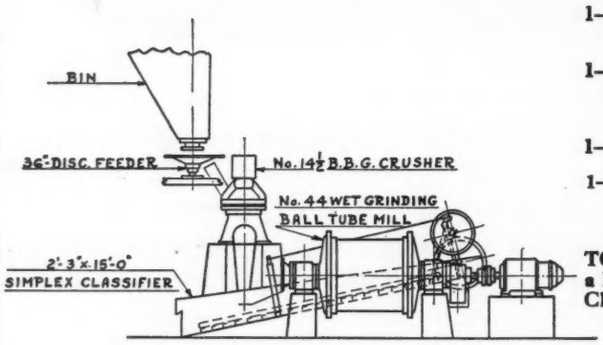
For a 50-ton mill requiring 43½ hp. per day of 24 hours approximately all thru a 90-mesh screen or as close as it can be classified by any classifier, use the following:



1—36" Disc Feeder and Bin Gate combined. ½ hp. motor required.

1—No. 14½ Special Kennedy Ball Bearing Gearless Crusher for Fine Crushing with a 3" receiving opening. It can be driven by a flat or K-V belt from a 20 hp. motor.

1—Simplex Rake Type Classifier requiring a 3 hp. motor.

1—No. 44 Gearless Tube Mill with flexible drive shaft. It requires a 20 hp. back-geared motor or it can be driven from a countershaft.

TO DOUBLE THE CAPACITIES MENTIONED ABOVE, use a No. 55 Gearless Tube Mill which requires 40 hp., and a Duplex Classifier requiring a 5 hp. motor.

Kennedy Ball Bearing Gearless Crushers with the troubles left out will crush more rock of any size than any crusher in the world with a saving of 50% in hp. and 80% in the cost of maintenance. They are built in sizes weighing from 1,000 to 900,000 pounds.

Write for particulars and catalogue showing our complete line of mining equipment manufactured in the United States, Canada, Australia, France and England.

This Mill shows savings in the following:

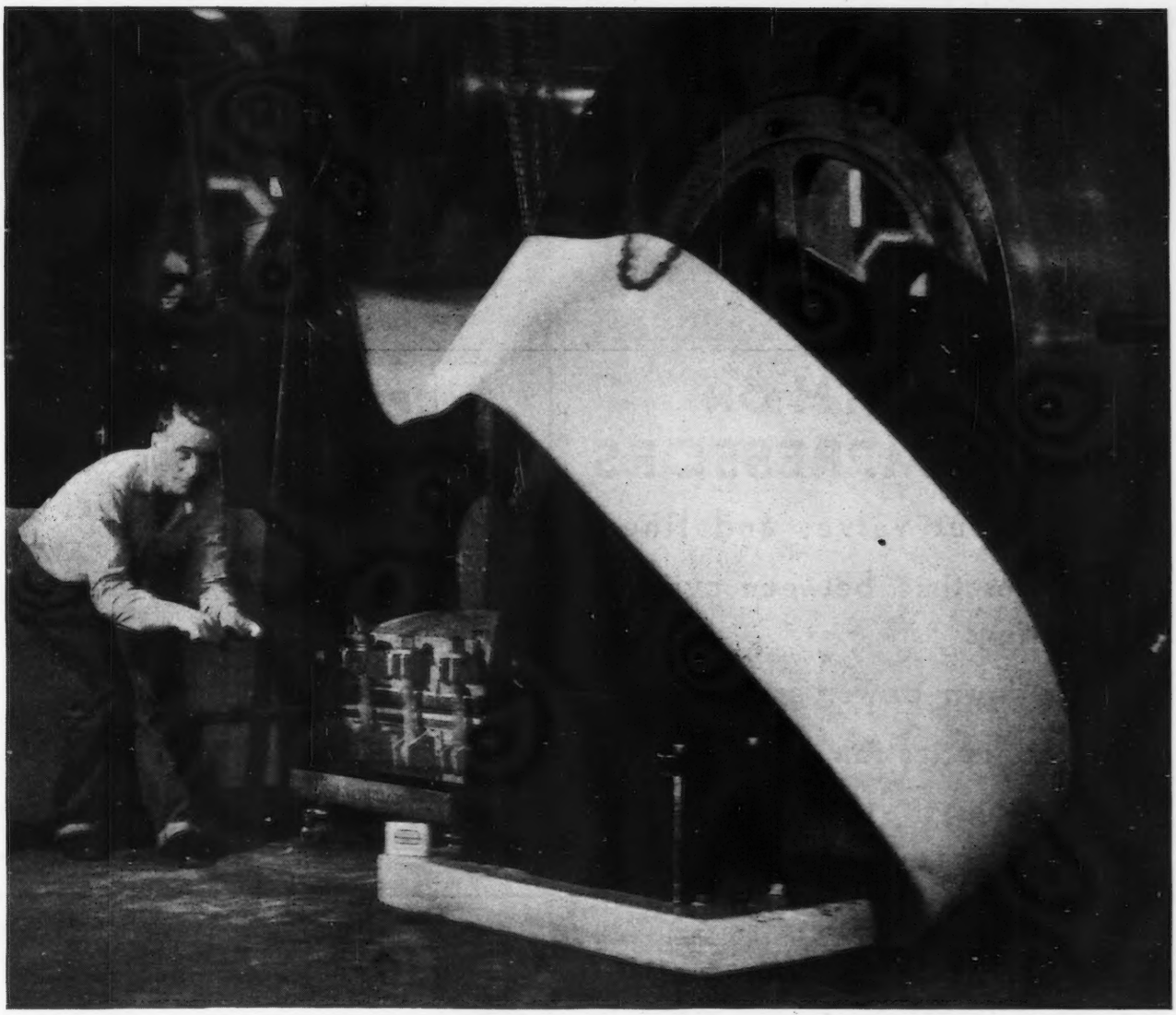
1. First cost of equipment.
2. Cost of freight.
3. Cost of foundations.
4. Cost of installing machinery.
5. Cost of building.
6. Cost of power.
7. Cost of maintenance.

But most important it gives a uniform sizing.

This setup gives the Tube Mill a feed of approximately 90% minus ¼" and therefore doubles its capacity over ordinary tube mill feed.

Before making definite recommendations, we should have a sample of your ore as our tables are based on medium hard clean ore.

KENNEDY-VAN SAUN MFG. & ENG. CORPORATION, 2 Park Ave., New York City



HE MAKES THE BELT SWALLOW ITS TAIL

A typical example of Goodrich improvement in rubber

FOR 40 years manufacturers tried to find a better way to make rubber belts endless.

Splices, vulcanized like tire repairs, would hold for a short time, then begin to open up at the seams. Plan after plan was tried, each plan designed to make splices *stronger and stronger.* Joints were made which seemed stronger than any other part of the belt! Still they failed.

One day Goodrich belt men decided that strength alone wasn't the answer. The outside belt plies must stand quick stretching and relaxing millions of times. Belts travel so fast that air resistance is important. These men decided they must protect those outer seams at any cost. So they reversed the usual engineering procedure, designed a splice in which a small section of an inner ply is removed, the outside ply carried under the surface at the seam, and covered with elastic breaker fabric.

Belts with this new Plylock splice lasted sometimes twice as long, sometimes ten times as long as the old belts. Users constantly tell us of serious belting problems which have been completely solved.

Goodrich is always busy with development work on rubber products. Much of it applies to new products, new uses —but no product is too "staple" or too *standardized* to get its share of this work. Goodrich improvements in rubber extend to conveyor belts, rubber-lined pipe, steam hose, suction hose—hundreds of other things classed generally as mechanical rubber goods. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

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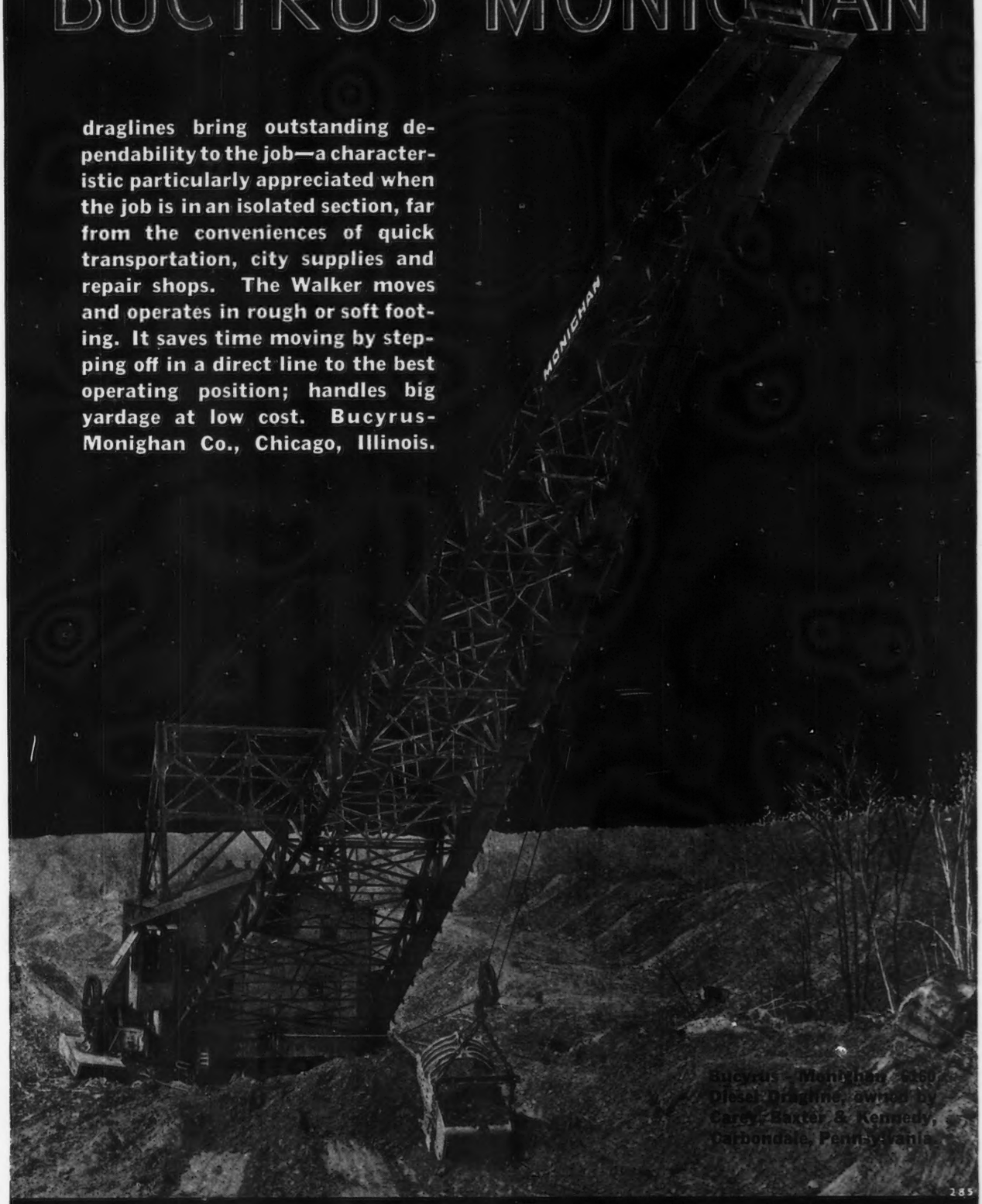
draglines bring outstanding dependability to the job—a characteristic particularly appreciated when the job is in an isolated section, far from the conveniences of quick transportation, city supplies and repair shops. The Walker moves and operates in rough or soft footing. It saves time moving by stepping off in a direct line to the best operating position; handles big yardage at low cost. Bucyrus-Monighan Co., Chicago, Illinois.



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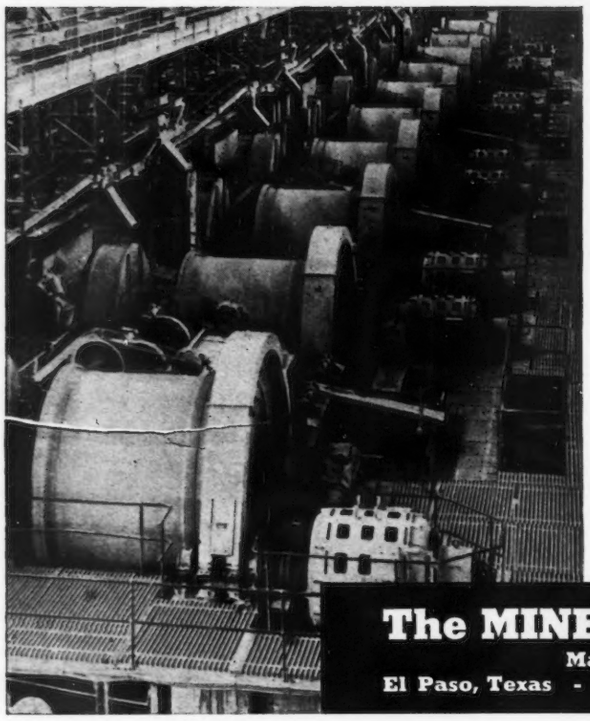

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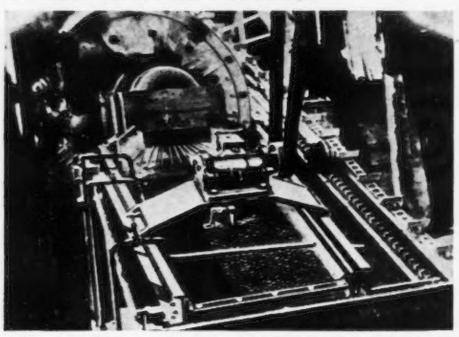

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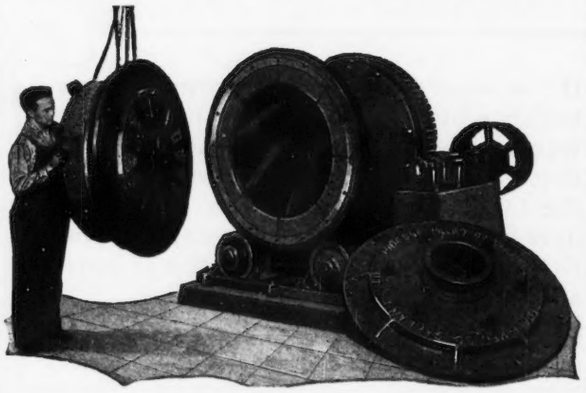

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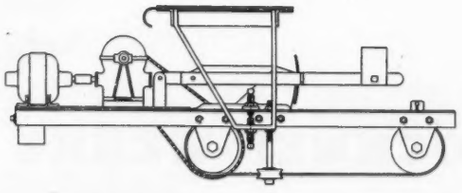

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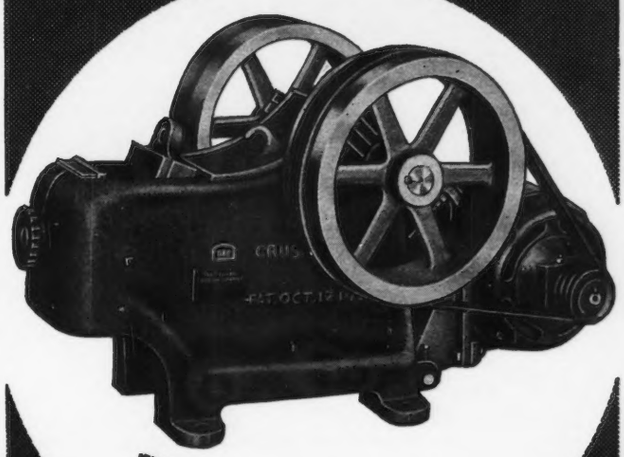

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DFC Laboratory Crushers are built in three sizes . . . power driven or hand operated. Complete data gladly sent on request.

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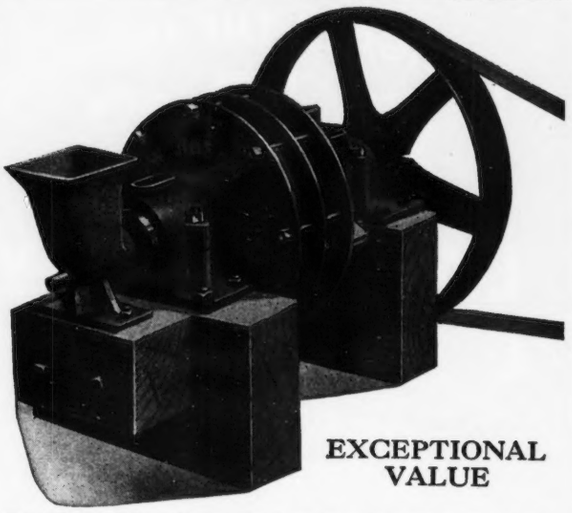

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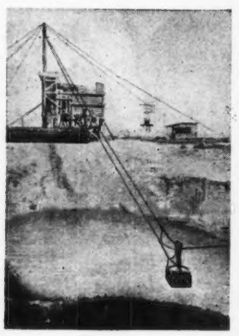

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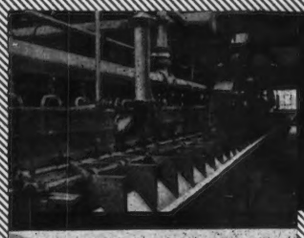
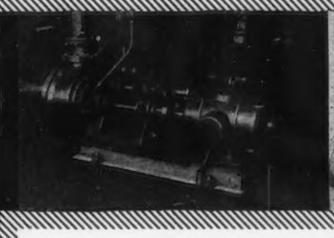
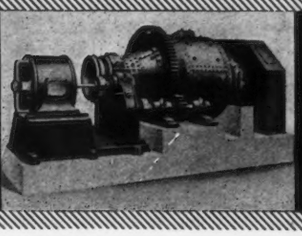
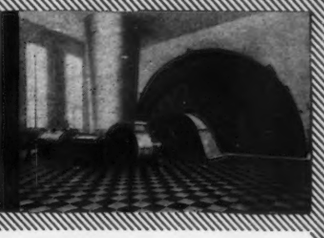
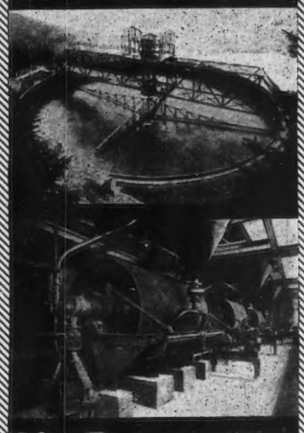
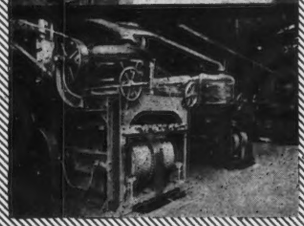

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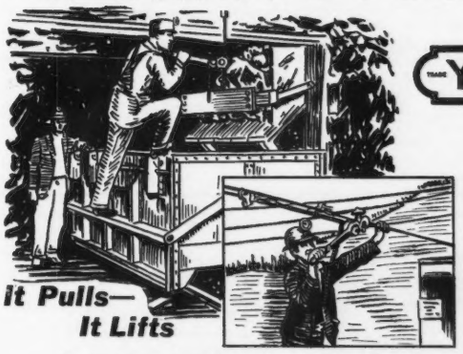

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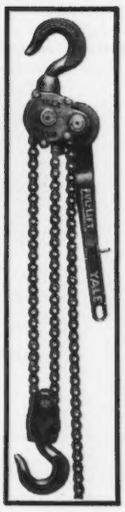

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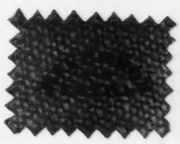

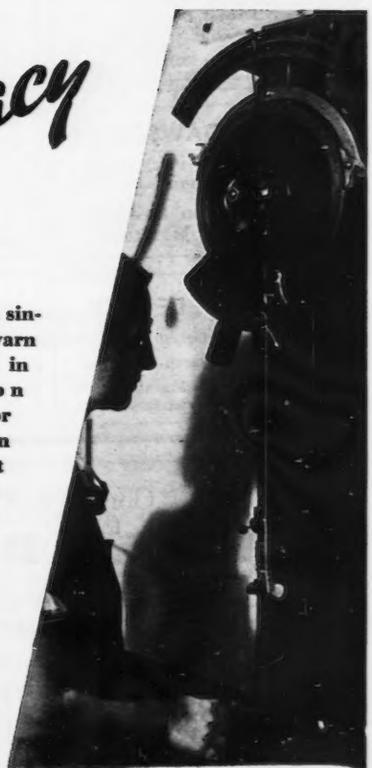

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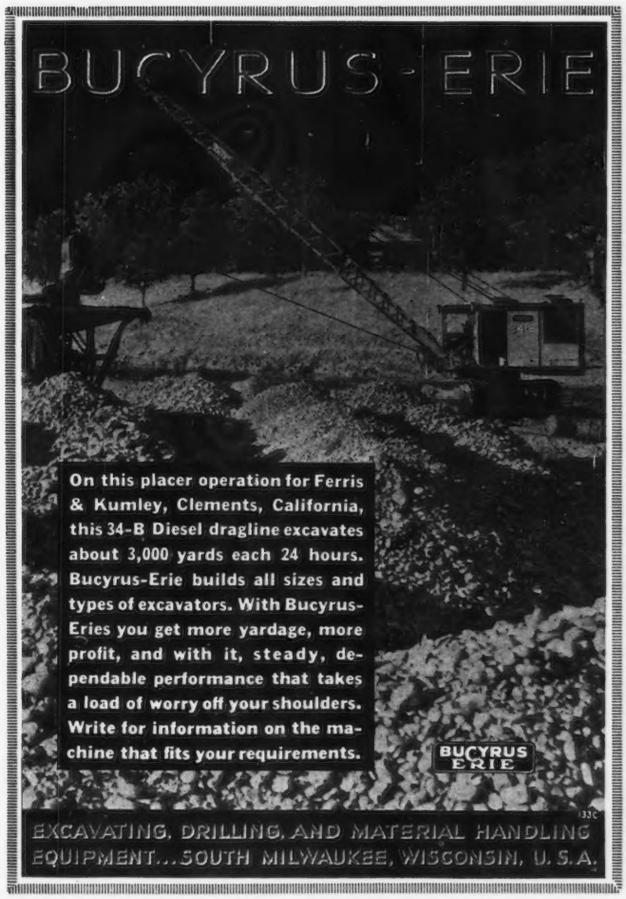
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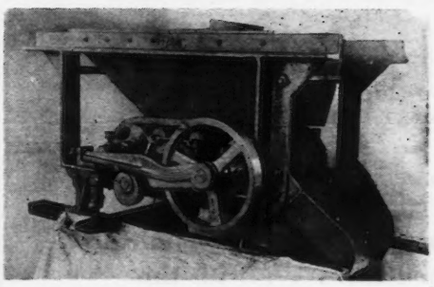

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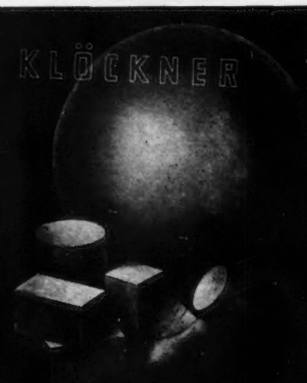

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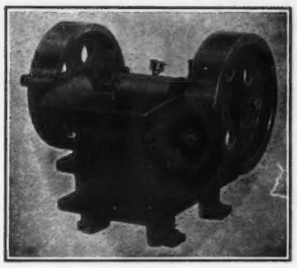

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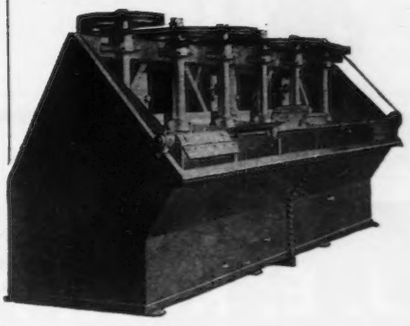

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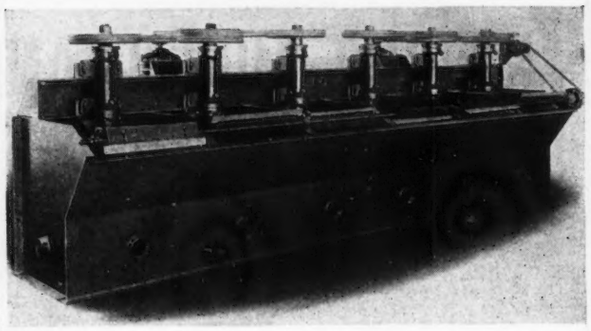

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2—Allis-Chalmers Style K, No. 3 Gyratory Crushers.
2—Allis-Chalmers Style K, No. 5 Gyratory Crushers.
1—Allis-Chalmers Style K, No. 6 Gyratory Crusher.
1—Allis-Chalmers Style K, No. 8 Gyratory Crusher.

THE EIMCO CORPORATION

634 So. 4th West, Salt Lake City, Utah, U.S.A. **Cable address "Eimco"**

For Sale

ONE HUNDRED TON MILL and MINE EQUIPMENT

Complete mining and milling plant, compressor drills, cars, rail, sharpener, steel and all mining accessories even to powder fuse and caps.

Also

100 ton Ball mill, crusher, classifier, Kraut flotation, assay office, cleanup room, etc., etc., office, bunkhouse, dining room.

Erected Less Than Year

Offered as a whole before dismantling Dec. 15th.

SNAP • PHONE • WIRE • WRITE

RAILS *CARS* *MACHINERY*

UNITED COMMERCIAL COMPANY, INC.

625 Market Street **San Francisco, California** **Phone: *Douglas 0430***

Good Used Equipment

6—Hardinge Ball Mills, 3'x8", 4½'x16", 6'x22", iron lined. Also larger sizes.
1—No. 32 Marcy Ball Mill, iron lined.
1—4'x8' Kennedy Ball Mill, iron lined.
2—6'x12' Hardinge Rod Mills.
5—Oliver Filters, 8'x8', 6'x6', 6'x4'.
2—Dorrco Filters, 10'x14'.
5—American Filters, 4' one disc, 6' two and four disc.
2—8'x6" and 9'6"x150' P. & M. Rotary Kilns.
2—8'x125' P. & M. Rotary Kilns.
3—8'x110' Bonnot Kiln.
1—6'x60' Bonnot Kiln.
4—6'x40' Direct Heat Rotary Dryers, ½" shells, double riveted butt strapped. Also larger and smaller sizes.
1—18"x36" Single Roll Crusher, Texrope drive, incl. motor.
1—7"x24" all steel Sturtevant Jaw Crusher, to ½".

Also all types and sizes of Jaw, Gyratory and Roll Crushers; Classifiers; Thickeners; Vibrating Screens; Separators; Pulverizers; Ball, Rod and Tube Mills; Rotary Kilns and Dryers; Filter Presses; Continuous Filters; Air Compressors; etc. Send for complete list.

CONSOLIDATED PRODUCTS CO. INC.

13-19 Park Row New York, N. Y.

Plant and Shops at Newark, N. J.
Cover 8 acres of ground
Cable Address: Equipment

Does Your Repair Shop Need a Lathe, Drill Press, Grinder or other shop tools?

Write for Free Copy of nationally advertised list of good used tools available at big savings.

Departmental Advertising Staff
McGraw-Hill Pub. Co., 330 W. 42d St., New York, N.Y.

SOMEWHERE

there's a buyer for the Equipment you no longer need. Reach him thru an advertisement in the SEARCHLIGHT SECTION.

IT WILL PAY YOU TO INVESTIGATE "WEMCO" MINING EQUIPMENT

Old-timers in the mining industry for over 20 yrs. have known the name . . .

"WEMCO"

. . . the sign of dependable attractively priced NEW and USED mining equipment.

AGITATORS

2—40'x28' Hollow Shaft, Radial Arms
3—40'x30' Propeller type, Deveraux Mech.
1—24'x16' Dorr Mechanism, Hollow Shaft
1—21'x14' Hollow Shaft, Radial Arms
1—13'x11' Hollow Shaft, Radial Arms

AMALGAMATORS

1—22"x18" Centrifugal Cone Bowl
1—24"x25" Gibson No. 1

ASSAY EQUIPMENT

1—Ainsworth Button Balance 0.002 mg.
1—Ainsworth Button Balance 0.01 mg.
1—Voland & Son Analytical Balance 0.1 mg.
1—Ainsworth Analytical Balance 0.5 mg.
1—Cone and Ring Assay Grinder
1—12"x30" Laboratory Ball Mill
1—McCool Pulverizer—Size 9½
1—Braun Pulverizer, Type U.A. 8" Discs.
1—No. 35 Braun Muffle Furnace, Gasoline
1—Hoskins Electric Muffle Furnace
1—No. 40 Braun Muffle Furnace, gas or gasoline
1—No. 18 Braun Melting Furnace, Gasoline
1—No. 4410 D.F.C. Muffle Furnace, oil
5—Wemco Laboratory Classifiers—Model C

BLOWER & EXHAUSTER

1—30" Discharge Sirocco Disc Type
1—18" Discharge National
1—12" Discharge Buffalo Type B
1—10" Discharge, Garden City, Combination
1—8" Discharge, No. 5 Sturtevant
1—8" Discharge, Sirocco D.C.

BLOWER—POSITIVE PRESSURE

1—10" Root, 4 lb. Pressure No. 2
1—7½" Nash, 16 lb. pressure, Hydro No. 3
1—7" Nash, 10 lb. pressure, No. 6
1—4" Sturtevant No. 2 Belted

CLASSIFIERS

4—6'x23' Wemco Duplex Rake
3—54"x16' Wemco Duplex Rake
4—27"x16' Wemco Simplex Rake
1—Fahrenwald Hydraulic, 6-chamber
3—Deister Hydraulic

COMPRESSORS—PORTABLE

7—315 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
1—315 cu. ft., I.R., 2-stage, Hesselman Oil Eng.
1—310 cu. ft., I.R., 1-stage, Waukesha Gas Eng.
6—210 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
1—210 cu. ft., I.R., 1-stage, Electric, Type 14
2—160 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
1—160 cu. ft., I.R., 2-stage, Hesselman Oil Eng.
1—160 cu. ft., Rix, 1-stage, Climax Gas Eng.
1—120 cu. ft., Rix, 1-stage, Le Roi Gas Eng.
1—118 cu. ft., G.D., 1-stage, Electric
12—105 cu. ft., I.R., 2-stage, Waukesha Gas Eng.

COMPRESSORS—SKID MOUNTED

1—315 cu. ft., I.R., 2-stage, Hesselman Oil Eng.
2—315 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
1—220 cu. ft., Sullivan, Buda Gas Engine
3—210 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
1—160 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
1—160 cu. ft., Rix, 1-stage, Climax Gas Eng.
10—105 cu. ft., I.R., 2-stage, Waukesha Gas Eng.
5—105 cu. ft., Wemco, 2-stage, Continental Gas Eng.
2—102 cu. ft., Wemco, 1-stage, Continental Gas Eng.
1—100 cu. ft., Schramm, 1-stage, Buick Gas Engine.

COMPRESSORS—STATIONARY

1—560 cu. ft., I.R., J-2, Belt Driven
1—469 cu. ft., Sullivan, WJ-3, Belt Driven
1—355 cu. ft., I.R., ER-1, Belted
1—345 cu. ft., Gardner, B-5, Belted
1—307 cu. ft., Sullivan WH-3, Electric, Belted
1—292 cu. ft., I.R., type 40, Electric, Belted
1—253 cu. ft., Chicago Pneumatic NSB
1—101 cu. ft., Sullivan WG-3, Belted
2— 80 cu. ft., Rix Duplex, Belted

CRUSHER—DISC

1—24" Symons, Belt Driven
1—13" Symons—Horizontal

CRUSHERS—GYRATORY

1—No. 6 McCulley—Belt Driven
1—No. 5 Austin, Belt Driven

FLASH!!

It was necessary to air mail this list to the publisher to avoid inclusion of equipment already sold. If you are in need of any of the equipment listed, our advice is that you——

WIRE FOR PRICES and COMPLETE DESCRIPTION

CRUSHERS—JAW

1—36"x9" Wheeling, Roll Jaw
1—36"x8" Universal make and type
1—15"x9" Chalmers, Blake type
1—12"x10" Llewellyn, Blake type
1—12"x10" Cedar Rapids Roll Jaw
1—10"x16" Power & Mining, Dodge type
1—10"x7" Joshua Hendy, Blake type
1—10"x6" Blake type
2—9"x7" Joshua Hendy, Blake type
1—6"x5" Universal type 1M
1—4½"x6" Dodge type
1—4"x6" Parke & Lacey, Dodge type

CRUSHING ROLLS

1—27"x15" Allis Chalmers Type A
1—20"x12" Plains Iron Works, Davis type

DRILLS—CORE—SHOT

1—Ingersoll-Rand Calyx, Class G-31
1—Ingersoll-Rand Calyx, Class GO

DRILLS—ROCK

Sinkers, Stopers, Drifters, Paving Breakers
Various Makes & Types

DRILL—WAGON

1—Cleveland, WDA-6, D-12, Drifter, Dry

FEEDERS—BALL MILL

2—Wemco 8"x3' Centers
3—Wemco 10"x12"x14"x3'4" Centers
1—Wemco 10"x12"x14"x6' Centers
4—Wemco 12"x14"x16"x8' Centers
2—Wemco 12"x14"x16"x10' Centers
3—Wemco 12"x14"x16"x12' Centers

FILTER PRESS

1—100 Ton Merrill-Crowe Precip. Plant

FILTER—VACUUM

1—3'x4' Oliver, Continuous

FLOTATION MACHINE

1—4-cell Sterns-Rogers, Air agitated
1—8-cell Greenwalt, Air agitated

GOLD TRAPS

Wemco Pulsating, 1-2-3-4-5 Compartment

HOISTS—AIR or STEAM

1—30-35 H.P. Orr & Senbower, 1-drum
1—12 H.P. Hendrie & Bolthoff, 1-drum
1—I.R., Utility, Type 10HX, d.d., 1500 lbs.
1—I.R., Utility, type HU, 2000 lb. pull
2—Sullivan Turbinair type HA-3 2000 lb. pull
1—I.R., Utility, Type EUA, 1250 lb. pull
3—I.R., Utility, Type D6U, 1250 lb. pull
2—I.R., 1H, Little Tugger, 1000 lb. pull
1—Leadville, Model 3—1000 lb. pull.

HOISTS—ELECTRIC

1—150 H.P., Dewco, Dbl. drum, Mine type
1—7½ H.P., Wemco, 1-drum, Mine type

HOISTS—NO POWER

1—35 H.P., Single drum, Mine type
2—25 H.P., Single drum, Mine type
1—25 H.P., Single drum, Contractors
1—15 H.P., Single drum, Contractors

MILLS—BALL, ROD and TUBE

2—9'x6' Marcy No. 96 Ball Mills
2—8'x6' Marcy No. 86 Ball Mills
4—6'x5' Cylindrical Ball Mills
1—5'x6' Placerville Gravel Mill
1—5'x5' Cylindrical Ball Mill
1—4'x3' Joshua Hendy Rod Mill
1—32"x7'1" Agnew Centripact

MILLS—STAMP

1—10-stamp Straub Circular No. 2
2—5-stamp, 1000 lb. batteries

PUMPS—CENTRIFUGAL

1—7" Morris 1-stage for Direct Connect.
2—6" Byron-Jackson, for Direct Connect
1—6" Cameron, Class DV, D.C. to Motor
1—5" Krogh, type B, Belted
1—4" Deming Mueller No. 4 Belted
1—3½" Byron-Jackson, D.C. to Motor
1—3½" Byron-Jackson, No. 60 Belted
2—3" I.R. Motorpump, Type 3-RVH-40
1—3" I.R. Motorpump, Type 2-RVL-15
1—2" I.R. Motorpump, Type 2-MRV-25
2—2" I.R. Motorpump, Type 2-RVH-10
1—2" Byron-Jackson, D.C. to Motor
1—1½" I.R. Motorpump, Type 1½-RVH-7½
2—1" I.R. Motorpump, Type 1-RV-3

PUMPS—DEEPWELL—ELECTRIC

1—4" Byron-Jackson, D.C. to Motor

PUMPS—DIAPHRAGM

2", 3" and 4" Wemco, New

PUMPS—DREDGE

1—6" Byron-Jackson No. 77, Belted

PUMP—POWER HEAD

1—Type H, Deepwell, Fairbanks-Morse, Belted

PUMPS—SUMP

6—I.R., No. 25 Portable, Air Operated
1—2½" Byron-Jackson, Pneumatic Sponge

PUMPS—TRIPLEX

1—7"x8" Deane, Belted
1—4"x6", Platt, Belted
1—4"x4", Gould, Belted

PUMPS—VACUUM

1—800 cu. ft., Nash Rotary
1—277 cu. ft., Nash Hydro No. 3
1—265 G.P.M. Goulds Horizontal
1—200 cu. ft., Oliver, J-11
1—91 cu. ft., Ingersoll-Rand, ER-2

SAMPLERS

2—Braun, power, "Universal"

SCREENS—VIBRATING

1—4'x5', Leahy, Single Deck
1—4'x6', Newago, Double Deck

SHARPENERS—DRILL STEEL

1—Ingersoll-Rand No. 24, Complete
1—Ingersoll-Rand No. 33, Complete
1—Sullivan type "B," Complete
2—Sullivan type "C," Complete

SHOVEL

1—¾ cu.yd. Thew, Power Gasoline

TABLES—CONCENTRATING

2—Deister Plat-o, V-belt drive
2—Deister Plat-o, flat belt drive
2—Deister Plat-o, geared motors
1—Wilfley, No. 6, flat belt drive
7—Myers, Model M, Belted

THICKENERS—NEW

1—85' Diam. Traction type mechanism
4—60' Diam., Type "C" Lifting Device
6—50' Diam., Type "A" Lifting Device
4—30' Diam., Type "A" Lifting Device
6—12' Diam., Type "A" Lifitng Device

WATER WHEELS

2—6' Pelton, Impulse & Reaction
1—24" Pelton, Enclosed

These items and others immediately available—Write or wire our nearest office

WESTERN MACHINERY CO.

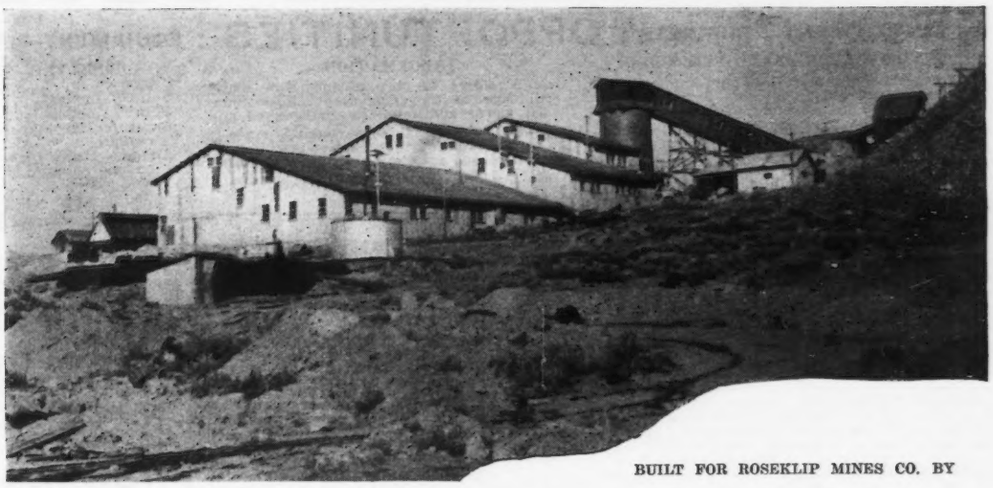
760-762 FOLSOM ST., SAN FRANCISCO, CALIF.

3649 Santa Fe Ave., LOS ANGELES, CAL. | **500 N. 16th Street, SACRAMENTO, CAL.** | **1025 So. Central Ave., PHOENIX, ARIZONA** | **210 Southwest Temple St., SALT LAKE CITY, UTAH** | **1863 Wazee St., DENVER, COLO.**

SERVING THE MINING INDUSTRY FOR OVER TWENTY YEARS

250 TON Cyanide Plant ★ ★ ★

for Treating Bodie Mine Dumps



BUILT FOR ROSEKLIP MINES CO. BY

WESTERN-KNAPP ENGINEERING CO.

500 North 16th Street
Sacramento, California

3649 Santa Fe Avenue
Los Angeles, California

CONSTRUCTION ENGINEERS
Complete Mine and Mill Installation
593 Market Street
San Francisco, Calif.

1025 South Central Ave.
Phoenix, Arizona

Cor. 3d South & 6th West St.
Salt Lake City, Utah

NO JOB TOO TOUGH FOR OUR ORGANIZATION

As a reader of the ENGINEERING and MINING JOURNAL you may have occasionally wondered whether or not "Searchlight" ads get results. These quotations from advertisers' letters may therefore prove interesting and an answer to your unspoken query:

GOLD MINES AVAILABLE

"I wish to compliment you on the splendid results, in the form of replies—directly in line with what we were advertising, namely available, proven, gold mining properties—which we are and have been receiving, since advertising with you."

"We are still getting replies to our advertisement, the last one referring to one of our first insertions, indicating that your publication is generally filed for future reference by your subscribers."

BUYER OF SPECIAL ORES

"—inquiries from nearly every state in the Union."

EQUIPMENT BUYER

"This letter is written for the specific purpose to state that there is not the least doubt but what advertising space in your Searchlight Section brings buyers and sellers together, and is the highest specialized service of this kind in existence. A perfect reference where one can have almost any requirement filled."

AN EQUIPMENT DEALER

"I know that you hear more kicks than you do compliments. I thought that you would like to know that recently through an inquiry that started in the Engineering and Mining Journal we have sold one customer $24,000.00 worth of equipment. As we have only used the Mining Journal for a short time we feel very much encouraged."

PLACER PROPERTY AVAILABLE

"We have had four answers to this ad."

EQUIPMENT FOR SALE

"During the past twelve months we have been engaged in closing out a considerable line of second hand machinery and equipment for a mining company in which we are interested, and as a result of a small advertisement in the Searchlight Section of the Engineering & Mining Journal, we sold upwards of $18,000 worth of machinery, which we secured exclusively through the columns of said Journal. It is needless to state that the results secured were highly gratifying."

POSITION WANTED ADVERTISER

"I am glad to state that notices in your Searchlight Section have almost always brought leads and my present and previous positions were the result of same."

POSITION VACANT ADVERTISER

"We can testify to the fact that your Want Ads bring results, as we have been swamped with replies—they come in faster than we can find time to read them."

MINE FOR SALE

"The ad has brought me 24 letters. I hope I will be able to sell the mine. It pays to advertise in the Journal."

EQUIPMENT FOR SALE

"It may be of interest to you to know that this ad brought many responses from all over the country, and even Canada, as a result of which I made an advantageous sale of the equipment offered."

Can "Searchlight" Serve You?

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD:

Positions Wanted (full or part-time salaried employment only), 5 cents a word, minimum $1.00 an insertion, payable in advance.

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

(Continued from pages 47, 48, 49, 50 and 51)

DISPLAYED—RATE PER INCH:

1 inch $6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

Rates for large spaces, or yearly rates, on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. E.M.J.

POSITION VACANT

WANTED — College graduate — metallurgist with experience in refining brass and aluminum in non-ferrous industry. P-709, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 26 years' recognized standing and reputation carries on preliminary negotiations for position of the caliber indicated through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 264 Delaware Bldg., Buffalo, N. Y. (E. M. J.)

POSITIONS WANTED

ENGINEER-DESIGNER: Experienced development of equipment, layouts, mechanical and structural design in milling, separating, furnace, drying and material-handling plants, desires responsible position. PW-706, Engineering & Mining Journal, 320 West 42nd Street, New York City.

FOREMAN, Mine Shift Boss, desires position responsible company. Graduate engineer. No preference as to location. Speaks Spanish. Married. PW-713, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

FOREMAN, Mine Shift Boss, desies permanent position reliable company. Graduate Engineer. Experience both open pit and underground. Speaks Spanish. Will go anywhere. Married. PW-710, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MANAGER, or Supt., by Engineer with wide and intensive experience in the development and operation of gold mines. Thoroughly familiar with all methods of extraction, mining, milling. Metallurgical test work, assaying, engineering, construction and hydro-electric development. Good health. Good record. Married. Speaks some Spanish. Box PW-695 E. M. J., 883 Mission Street, San Francisco, Calif.

MINING ENGINEER, 32, single, desires position as Engineer, Mine or Flotation Mill Superintendent. Qualified to supervise mine development and exploitation, mill construction and operation. Location United States preferred. References. PW-711, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MINING ENGINEER, aged 32, desires position as mine foreman, or superintendent, married, no children, speaks Spanish; ten years' experience in U. S. and foreign countries in operating end, will go anywhere. PW-712, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MINING ENGINEER—40—15 years' experience in min.ng. Wishes position as foreman, manager or superintendent. Available on short notice. Go anywhere. PW-714, Engineering & Mining Journal, 883 Mission Street, San Francisco, Calif.

CONTACT WANTED

KEY MAN OF 20 YEARS MINING EXPERIENCE will examine, investigate analyze and operate any selected property, devoting full time with remuneration on a percentage basis ONLY. Am also in contact with valuable mining properties requiring as little as $40,000 for development. Not interested in Mining Promoters or stock issues.

Address **W. F. CROUCH**
1015 Central National Bank Bldg., Oakland, Calif.

BUSINESS OPPORTUNITIES

For the information of Readers:
Organizing and incorporating costs incurred in connection with capital raising are usually quoted as a separate cost not conditioned upon or related to the actual raising of capital or any fees earned thereby.

Raising Capital

Inquiries solicited from corporations interested in raising capital through marketing corporate securities. The Brookworth Co., Inc., 10 East 42d St., New York, N. Y.

940-Acre Gold Property

WILL SELL part interest to finance work and complete mill. Property 65 miles north of Boise, Idaho, on state highway. Electric power easily available. Timber and water plentiful. 1000-foot tunnel necessary to complete development work and intersect 5 quartz veins, 2 to 5 ft. wide, $20.00 to $60.00 values. Engineer's report available. Write BO-715, Engineering & Mining Journal, 520 North Michigan Avenue, Chicago, Ill.

For Sale or Trade

Nine placer and one lode claim in Mariposa County, California; or will give one-half interest to anyone who will equip and operate them. Wm. S. Dillon, 223 W. Harrison St., Danville, Illinois.

Custom Mill Wanted

Engineer offers opportunity for 50 ton mill in high-grade Nevada gold district. Address P. O. Box 105, Laguna Beach, Calif.

DIVIDEND NOTICE

ANACONDA COPPER MINING CO.
25 Broadway New York, November 19, 1936.

DIVIDEND No. 116—The Board of Directors of the Anaconda Copper Mining Company has declared a dividend of Twenty-five Cents (25c) per share, and an extra dividend of Twenty-five Cents (25c) per share upon its Capital Stock of the par value of $50. per share, payable Dec. 21, 1936, to holders of such shares of record at the close of business at 3 o'clock P.M., on Nov. 30, 1936.

D. B. HENNESSY, Secretary.

THE TONOPAH MINING CO. OF NEVADA

EXPLORATION DEPARTMENT

Prospects of Merit Financed

Write Either

H. A. JOHNSON, Supt. of Operations, Tonopah, Nevada
Or Main Office 570 Bullitt Bldg. Philadelphia, Pa.

New "SEARCHLIGHT" Advertisements

must be received by December 30th to appear in the January issue.

Address copy to the Departmental Advertising Staff

Engineering and Mining Journal
330 West 42d St., New York City

WE BUY GOLD

Concentrates or residues. Scrap gold or residues containing silver or platinum in any payable form. Any quantity, large or small.

SHERMAN & CO.
Precious Metals Refiners
66 Bowery New York

CHAIN O'MINES, INC.

1713 Mallers Bldg., CHICAGO
Tel. Dearborn 9233
Wm. Mark Muchow, Pres.

WANTED—mining properties containing very large tonnages of gold, silver chromium or other precious metal ores (low grade). Will also buy large capacity "used" milling and mining equipment—assay plants.

GOLD PROPERTY WANTED

Advertiser desires to secure for financial interests substantial gold property having indications of developing into a mine of considerable magnitude. Mail complete details.

BO 683 Engineering & Mining Journal
520 No. Michigan Ave., Chicago, Ill.

GOLD MINE FOR SALE

Located in one of the best mineral districts of U. S.—35,000 tons developed ore averaging better than $12.00 gold—36 smelter shipments sorted ore averaged $33.00 net—Tunnel entrance—Reasonable terms.

BO-716, Engineering & Mining Journal
520 No. Michigan Ave., Chicago, Ill.

FOR SALE

VANADIUM MINE, COLORADO

New property, large ore bodies averaging 3 to 4% V_2O_5

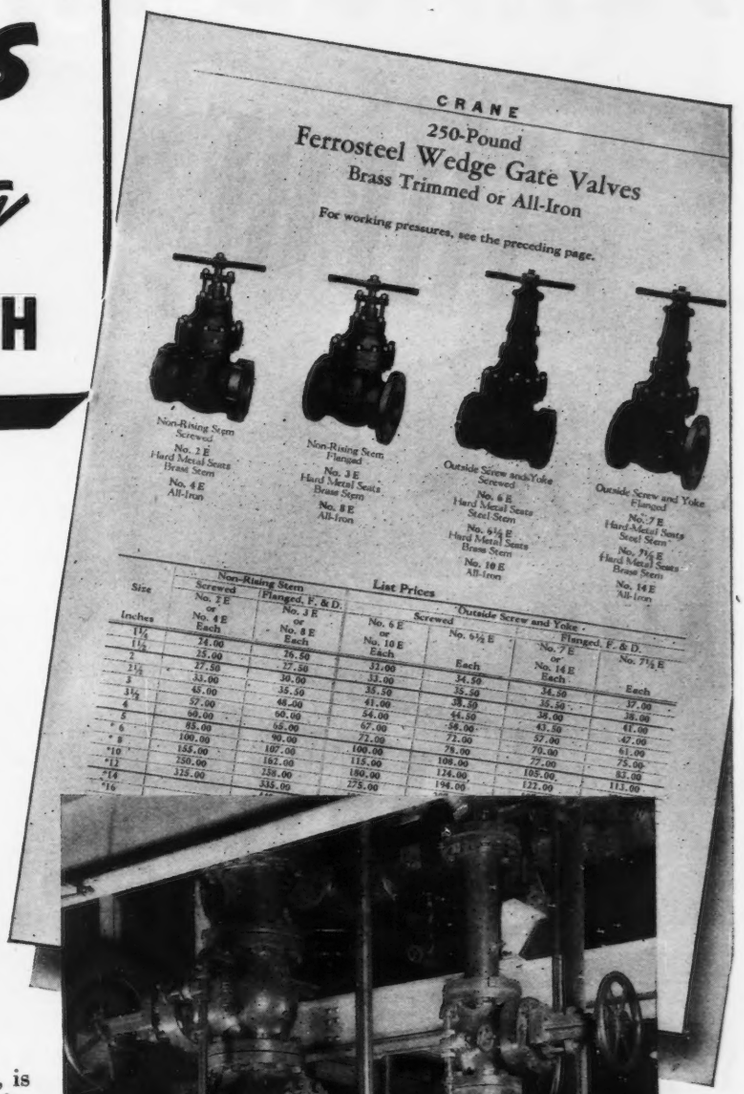
Clean sandstone ore, 500,000 lbs. V_2O_5 in sight. Favorably located; 1½ miles from R.R. Engineer's report available to responsible parties. Foreign correspondence invited.

J. V. ROSE, Glenwood Springs, Colorado

Don't forget the Box Number

WHEN answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

FOR SERVICES *Requiring* EXTRA STRENGTH


CRANE

250-Pound
Ferrosteel Wedge Gate Valves
Brass Trimmed or All-Iron

For working pressures, see the preceding page.

Non-Rising Stem Screwed
No. 2 E
Hard Metal Seats
Brass Stem
No. 4 E
All-Iron

Non-Rising Stem Flanged
No. 3 E
Hard Metal Seats
Brass Stem
No. 5 E
All-Iron

Outside Screw and Yoke Screwed
No. 6 E
Hard Metal Seats
Steel Stem
No. 6½ E
Hard Metal Seats
Brass Stem
No. 10 E
All-Iron

Outside Screw and Yoke Flanged
No. 7 E
Hard Metal Seats
Steel Stem
No. 7½ E
Hard Metal Seats
Brass Stem
No. 14 E
All-Iron

List Prices

Size	Non-Rising Stem Screwed No. 2 E or No. 4 E Each	Non-Rising Stem Flanged, F. & D. No. 3 E or No. 5 E Each	Outside Screw and Yoke Screwed No. 6 E or No. 10 E Each	Outside Screw and Yoke Screwed No. 6½ E Each	Outside Screw and Yoke Flanged, F. & D. No. 7 E or No. 14 E Each	Outside Screw and Yoke Flanged, F. & D. No. 7½ E Each
Inches						
1¼	34.00	36.50	37.00	34.50	34.50	37.00
1½	35.00	36.50	37.00	34.50	34.50	37.00
2	27.50	37.50	37.00	35.50	34.50	38.00
2½	33.00	30.00	33.00	34.50	35.50	37.00
3	45.00	35.50	35.50	35.50	34.50	38.00
3½	52.00	48.00	41.00	38.50	35.50	37.00
4	60.00	60.00	54.00	44.50	38.00	38.00
5	85.00	66.00	67.00	58.50	43.50	47.00
6	100.00	90.00	72.00	72.00	57.00	47.00
*8	155.00	107.00	100.00	78.00	70.00	61.00
*10	250.00	162.00	115.00	108.00	77.00	75.00
*12	325.00	238.00	180.00	124.00	105.00	83.00
*14		336.00	275.00	194.00	122.00	113.00
*16						

● There are many services in the mine power plant, on the surface and on lower levels, which necessitate the use of valves which are more rugged, stronger and less affected by temperature, piping and other strains than cast-iron valves. For these services Crane No. 7-E Ferrosteel Wedge Gate Valves are an economical investment. They are rugged, strong and substantial, sustaining with ease the strains and stresses of 250-pound steam working pressure at 500° F., and of high-pressure water, air, gas or oil services.

The Ferrosteel used for the bodies and bonnets has a tensile strength approximately 35 per cent greater than cast iron. Further strength and resistance to distortion is given these parts by scientific distribution of the metal. Seats are made of Crane Hard Metal, a copper-tin bronze of unusual strength and hardness screwed into the body. The disc in the smaller sizes is of the same hard metal and, in the larger sizes, is faced with it. The use of Crane Hard Metal for these purposes reduces wear, wiredrawing and corrosion to a minimum.

Only minimum maintenance is required. Repacking can be easily and quickly done.

The careful design and the stamina of this valve are typical of that which identifies all Crane valves and fittings. There is a Crane branch or distributor in your vicinity who can supply most needs from stock.

Let Profits Pay for Plant Improvements. Use the Crane Finance Plan.

Crane 7-E Extra Heavy Gate Valve in water-pump service. This and similar valves are described on page 83 of the new Crane No. 52 Catalog

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO, ILL. • NEW YORK: 23 W. 44TH STREET

Branches and Sales Offices in One Hundred and Sixty Cities

VALVES, FITTINGS, FABRICATED PIPE, PUMPS, HEATING AND PLUMBING MATERIAL

TEXACO AT WORK

HERE shows up . . HERE

MAINTENANCE RECORD

HOIST HOUSE
MINE NO. 3

SHENANGO COAL CO.
REEDSBURGH, PA.

ITEM	TIME	PARTS	COSTS	DATE	
	140		145.12	1/2/40	
	780		5420	3/2/40	
	2184		15200	8/12/40	

You can expect reduced maintenance costs when you put Texaco to work.

There are special Texaco Mine Car Lubricants for every type of mine car bearing.

Each is scientifically designed in cooperation with car and bearing manufacturers. Each has proven its ability to fill a specific need.

That is why the right Texaco Mine Car Lubricant will:

Lower your starting and running power consumption . . .

Seal bearings against entrance of dust and grit . . .

Adhere to bearing surfaces and effectively lubricate in cold, damp mine passages . . .

Definitely extend the time between applications . . .

A Texaco representative will be glad to provide practical engineering service to prove the economy of Texaco Products.

☆ ☆ ☆

THE TEXAS COMPANY
135 East 42nd Street, New York City

Nation-wide distribution facilities assure prompt delivery

TEXACO
REG. T. M.

TEXACO *Industrial Lubricants*

MARKS THE SPOT

to guard against hold-ups!

Unless your crushing equipment is made of the toughest materials, it is one of the most dangerous threats in the whole production cycle. A broken shaft, for example, may hold up the ore flow for hours, shutting down operations all along the line. But when shafting and other highly stressed parts of essential equipment are made of tough, strong Nickel Alloy Steels, costly interruptions are seldom experienced. We invite consultation on the use of suitable Nickel Alloy Steels, Nickel Cast Irons and other alloys containing Nickel in your mining machinery.

CAST IRONS

NICKEL

ALLOY STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

THAT'S REAL PIPE!

NATIONAL COPPER-STEEL PIPE

WATER dripping and drying . . . pipe now wet — now dry . . . again and again — that's one of the hardest things on pipe in mine service. It's like atmospheric corrosion (alternate wet and dry condition) speeding along in high gear.

NATIONAL Copper-Steel Pipe has proved in more than 20 years of use that it resists this type of corrosion, gives longer life with fewer interruptions and delays, and cuts cost of maintenance. In addition to giving protection from alternate wet and dry conditions, Copper-Steel pipe is resistant to acid mine waters.

Of course, the cost is just a little higher than non-Copper-Steel pipe, but the extra service is more than worth the difference. Always order it, and when you do, be sure to ask for NATIONAL Copper-Steel—the original Copper Steel Pipe.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

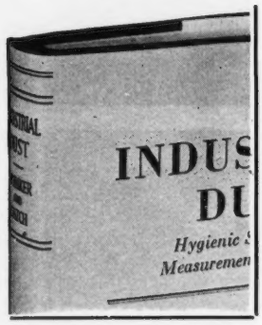
Columbia Steel Company, San Francisco *Pacific Coast Distributors*

United States Steel Products Company, New York *Export Distributors*

UNITED STATES STEEL

Dust in industry —

what the hazards are; how to determine their existence; how to combat them



This book covers the problem of dust control in its relation to the health of workmen, emphasizing the cooperative nature of the problem both for physicians and engineers, and presenting principles, methods and data for the design and operation of dust-control equipment.

Just published

Industrial Dust

Hygienic Significance
Measurement and Control

by PHILIP DRINKER
Professor of Industrial Hygiene, Harvard School of Public Health

and THEODORE HATCH
Instructor in Industrial Sanitation, Harvard School of Public Health and Harvard Graduate School of Engineering

316 *pages*, 6 *x* 9, 104 *illustrations*, $4.00

The arrangement of this book is a comprehensive, critical presentation both of scientific and technical aspects of the industrial dust problem.

The purpose is to give engineers and physicians an introduction to the hygienic significance of the problem and a development of the principles and methods of measurement, analysis and control of dust conditions that will enable them to deal effectively with the problem as encountered in specific industrial situations. It discusses the physical aspects of dust and fume suspensions and their effect upon man; the analysis, measurement, and microscopy of fine dusts; and the practical control of dusts and use of respiratory protective devices.

Read these chapter headings

- Physical Properties of Dusts, Fumes and Mists
- Effects of Dusts and Fumes upon Man
- Physical and Chemical Factors in Pneumoconiosis
- Permissible Dustiness
- The Dust Survey
- Dust Determination
- Determination of Particle Size
- Chemical and Mineralogical Analyses
- Control of the Dust Hazard—General
- Design of Local Exhaust Systems
- Air-cleaning Apparatus
- Air-cleaning Apparatus—Filtration
- Dust Respirators and Air Masks

McGRAW-HILL ON-APPROVAL COUPON

McGRAW-HILL BOOK COMPANY, INC.
330 West 42d Street, New York, N. Y.

Send me Drinker and Hatch — Industrial Dust, for 10 days' examination, on approval. In 10 days I agree to pay $4.00 plus few cents postage and delivery, or return book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....

Address .....

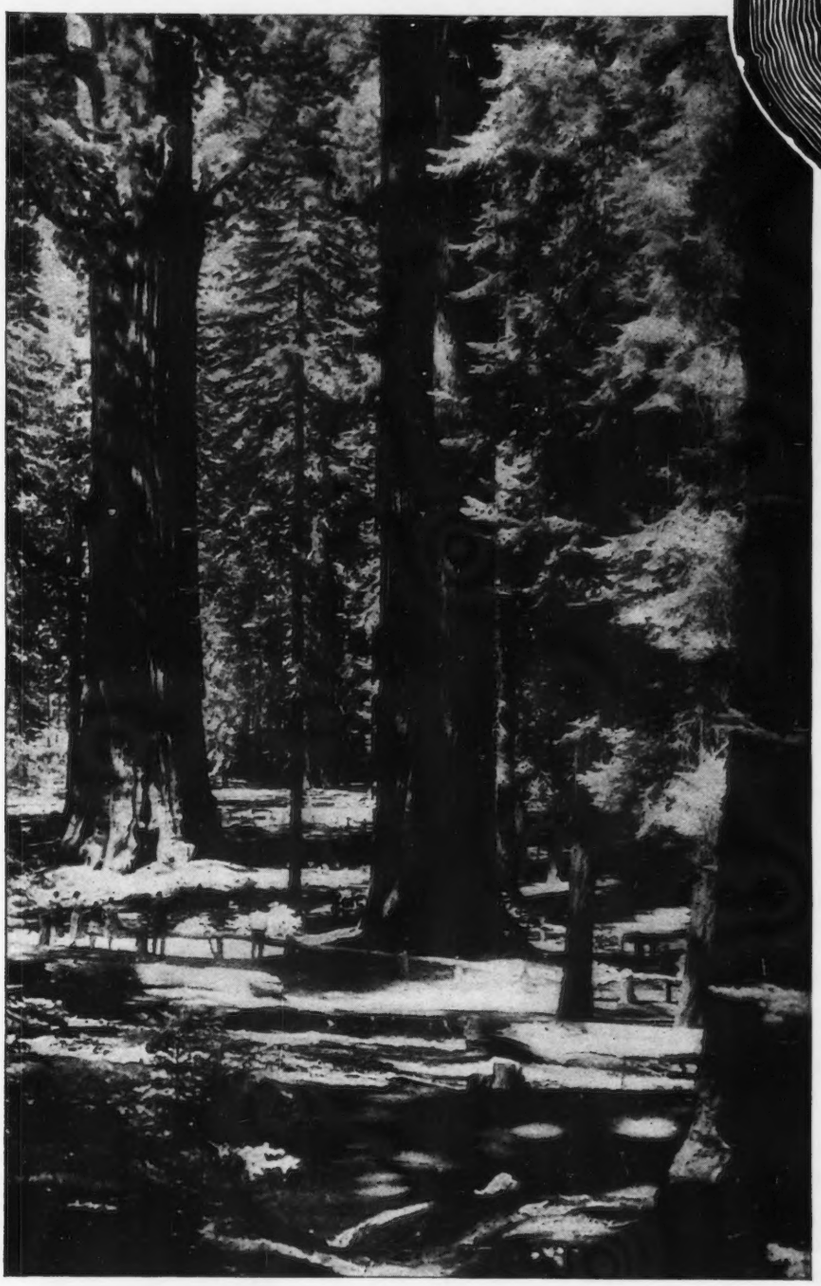
City and State .....

Position .....

Company J-12-36

(Books sent on approval in U. S. and Canada only.)

GREATER GROWTH with Every Year



HIGHER worth of product, broader industrial research and increase of manufacturing facilities have marked the progress of Republic, year after year.

Long ago, this organization established new standards of quality for Transmission and Conveyor Belting, Hose, Packing and other mechanical rubber products. These high standards of ultimate value, which we have long maintained, are fully appreciated by industry and are bearing their logical fruits in larger and larger demands.

Applied to the particular uses for which they are made, Republic Products are unexcelled in economy and efficient performance.

The REPUBLIC RUBBER Company

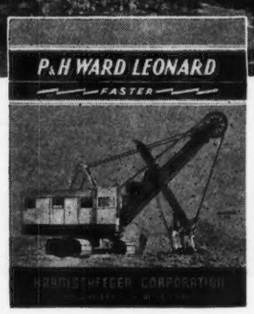
YOUNGSTOWN • OHIO

Manufacturers of HOSE
BELTING • PACKING
MOLDED PRODUCTS

ORDER REPUBLIC RUBBER PRODUCTS FROM YOUR DISTRIBUTOR

NOT ONLY *Faster* BUT *Easier* TO RUN

In all kinds of open-pit operations, the P&H Ward-Leonards show up with the higher production that means lower costs on every ton of material moved. This faster digging cycle is due not only to mechanical improvements, but because the machine itself is so much easier to operate with simple electrical controls for every movement in travel and digging . . . a true one-man machine . . . the first of its kind. . . . . Your investigation will bear proof of the fact that the P&H Ward-Leonard is able to dig 15% more than any other machine of its size under similar conditions.



The engineering story behind the P&H Ward-Leonards is fully covered in this new Bulletin X-9. Your copy will be forwarded upon request.

HARNISCHFEGER CORPORATION

4454 West National Avenue Established 1884 Milwaukee, Wis.

THE BEST BIT *That Can Be Made*

Our first consideration in the manufacture of Timken Bits is quality.

Our policy is (1) to produce the best bits that can be made, and (2) to sell them at the lowest possible prices consistent with their superior quality.

There are removable bits on the market that can be bought for less than Timken Bits, but the operator who weighs price against performance can easily see the wisdom of paying a few cents more per bit to get the faster drilling, increased footage and longer life of Timken Bits.

Look for the name "TIMKEN" stamped on every removable bit you buy.

Complete Stocks Maintained in Principal Distributing Centers

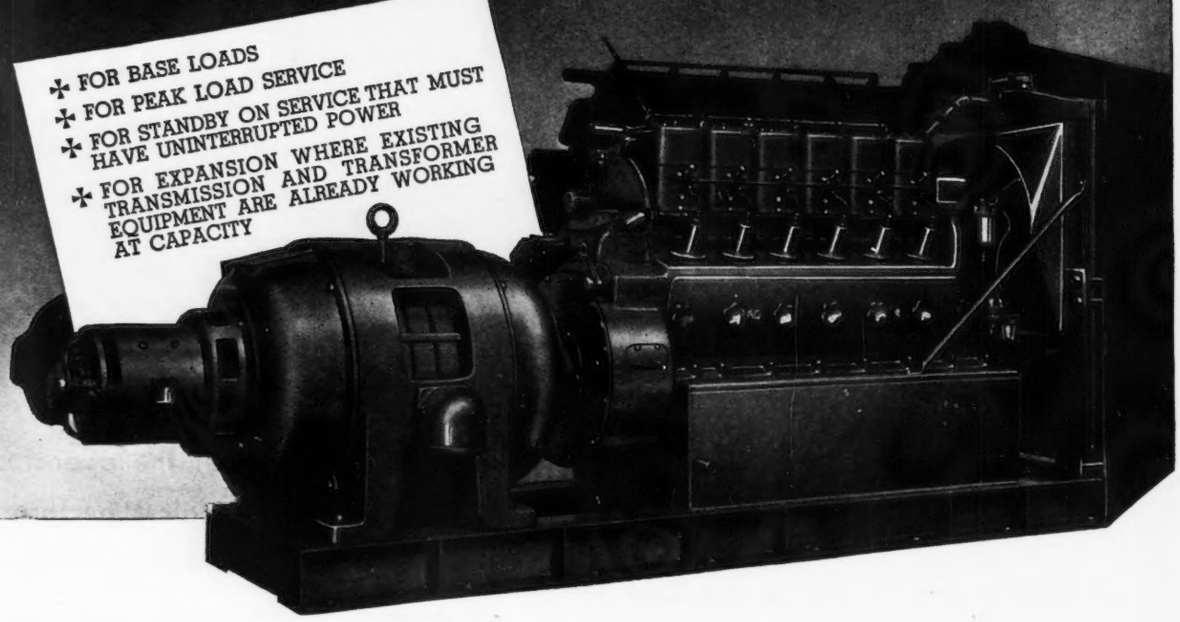
THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN BITS

MARKS THE SPOT

...where an F-M "36-A" Diesel Driven Generating Set Can Serve Your Business

- FOR BASE LOADS
- FOR PEAK LOAD SERVICE
- FOR STANDBY ON SERVICE THAT MUST HAVE UNINTERRUPTED POWER
- FOR EXPANSION WHERE EXISTING TRANSMISSION AND TRANSFORMER EQUIPMENT ARE ALREADY WORKING AT CAPACITY



WHICH one of these conditions applies to you? If power costs are too high . . . if peak load service demands additional power — if present equipment is already loaded to capacity —then an F-M "36-A" Diesel-driven generating set is needed on the job.

These compact, powerful "packages of power" take up little space, burn cheap grades of oil, need little attention. In return, they deliver current where it's needed, when it's needed, at amazingly low cost. Why not find out today how they can serve you? For full information, address Department O-871, Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 branches at your service throughout the United States.

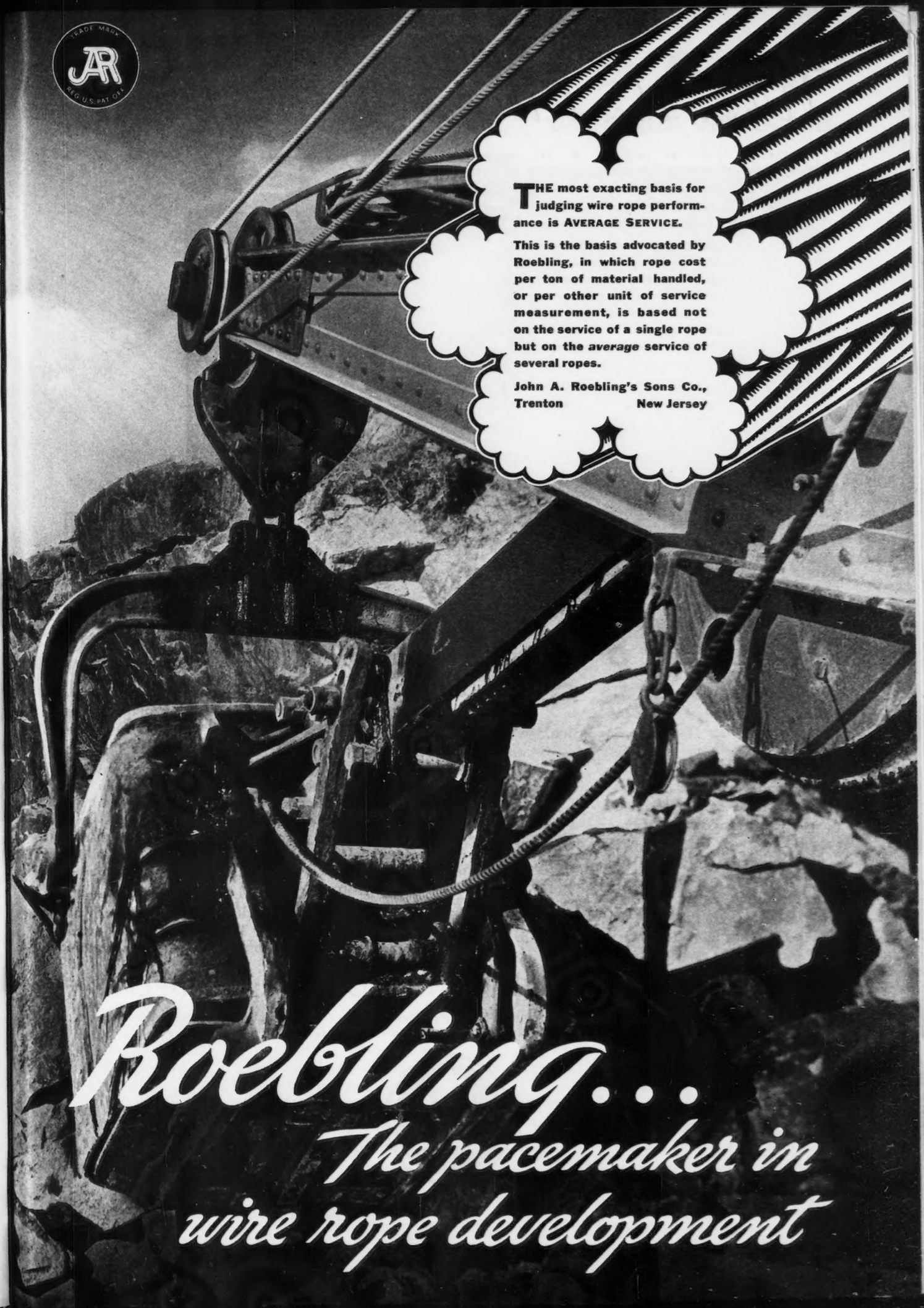
106 YEARS OF PRECISION MANUFACTURING

FAIRBANKS-MORSE

Diesel Engines

POWER, PUMPING AND WEIGHING EQUIPMENT

66050A40-27


TRADE MARK
JAR
REG. U.S. PAT. OFF.
THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.
This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.
John A. Roebling's Sons Co., Trenton New Jersey
Roebling...
The pacemaker in wire rope development

When the drills strike tough rock

MIDVALE

DRILL STEEL STANDS UP

Back of longer life, better-service, there is always a reason. Midvale's method of making carbon and hollow drill steel is slower and more costly than may seem necessary to some. But it results in the highest grade of steel that can be produced.

Midvale charges with cold metal in the first place—inspection at the start. After the ingots cool, inspects again for faults, chipping out any surface defects. Ingots are then reheated, reduced to billet size, the scale sand-blasted—and inspected again, chipping when necessary. The billets are again reheated and rolled to finished size. In Midvale hollow drill steel billets the holes are drilled, not punched, insuring smooth, concentric bores.

In rock work and drilling of all kinds the extra hours of life in a tool are worth real money. They are worth the extra time and trouble Midvale took when that steel was being made.

THE MIDVALE COMPANY • • NICETOWN, PHILADELPHIA

OFFICES: *New York • Chicago • Pittsburgh*
Washington • Cleveland • San Francisco

"Now, THIS Stuff Is Good,"

SAYS THE OPERATOR

THIS operator, who is shown in the picture, is an expert machine runner in a Pennsylvania coal mine. He has been running this cutter for about three years; he knows the machine well, and he also knows the cable.

"How long has this been on?" we asked.

"About two years," he answered.

"This cable must have been well taken care of," we ventured; "you watched that wheels didn't run over it and . . . ".

"No," he replied. "You see this machine is used on three shifts and I run it only on one shift."

We looked over the cable as carefully as the light from our lamp would allow, found a couple of splices, but couldn't see any signs of wear or of nicks.

"What did you have on before this?"

"Some round cable that was not so good; it wore out too fast. Now this stuff is good."

Worse Than Ordinary Service

The mine foreman added, "You see this is pretty hard service. The cable is dragged over the coal and around posts, and the mine is wet. Then this cutter is an old model, it hasn't a trolley. So when we want to move it we have to use the cable for power. If we want to run it 2,000 feet, we run the machine as far as the cable will let it go, then stop, go back and unhook the cable, drag it up to the machine, connect it, and go on again. So, you see, that is worse than ordinary service."

Give Tellurium a Trial

For cutters, loaders, electric shovels, and reel locomotives, G-E tellurium-rubber cable *is* good stuff. It's tough and will stand much abuse. The mining men we talked to—from the company managers to the machine runners—all say that it gives most satisfactory service. Try it. See your G-E jobber; he can supply all types and sizes. For prices and specifications, see Bulletins GEA-1728 and GEA-1918. Address nearest G-E jobber, G-E sales office, or General Electric, Dept. 6A-201, Schenectady, N. Y.

●

This ad is one of a series written after visits to coal mines in Pennsylvania, West Virginia, and Ohio. Names of the mines and of the men interviewed will be furnished on request.

520-79

GENERAL ELECTRIC

FROM PRODUCTION ENGINEER TO FRONT OFFICE... TO
SALES MANAGER TO SALESMEN...TO
PROSPECT'S PURCHASING AGENT... TO
THE MEN AT THE TOP WHO SAY "YES" OR "NO".
Advertising takes your sales story unchanged to the buyer.

There's many a step between the men who build your product and the men who buy it. Too many to entrust its complete sales story to all the uncertainties of word-of-mouth transmission.

That's the job for advertising!

Put the advantages of your product in printed messages and send them—in the right business papers—straight to all the key men in your markets. Then you can be certain not only of a hearing, but of a fair and effective hearing.

With McGraw-Hill's thorough and effective coverage of all the buying factors in the various industrial markets, it can be an economical hearing, too. Ask to have a McGraw-Hill representative show you how economically the job can be done.

McGRAW-HILL PUBLICATIONS

McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York, N. Y.

American Machinist
Aviation
Bus Transportation
Business Week
Coal Age
Chemical and Metallurgical Engineering
Construction Methods
Electrical Contracting
Electrical Merchandising
Electrical West
Electrical Wholesaling
Electrical World
Electronics
Engineering and Mining Journal
Engineering News-Record
Factory Management and Maintenance
Food Industries
Metal and Mineral Markets
Mill Supplies
Power
Product Engineering
Radio Retailing
Textile World
Transit Journal

Complete Metallurgical Service

Flotation **Cyanidation** **Amalgamation** **Gravity Concentration**

Ore Testing. Our laboratories are fully equipped to investigate all problems in ore dressing. Accurate and complete data for the design of ore treatment plants is obtained by thorough testing in the laboratory and submitted in a complete and detailed report with recommendations that will produce greatest economies.

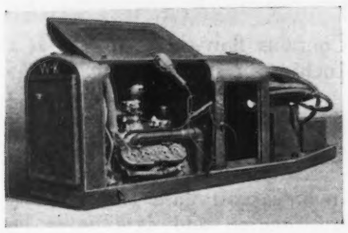
Plant Design & Construction. Complete plans and specifications for plants of any specified tonnage are prepared by an experienced technical staff to meet all requirements of treatment and of local conditions. Construction is supervised by a resident engineer and within a minimum period the plant is in profitable operation.

Equipment. We can supply all of the necessary equipment for complete milling plants.

All inquiries will receive our prompt attention

THE GENERAL ENGINEERING COMPANY
159 PIERPONT ST., SALT LAKE CITY
TORONTO NEW YORK CITY LONDON

W-K FORD V-8



AIR COMPRESSORS
LOW COST—LIGHTWEIGHT—TWO SIZES
PARTS AVAILABLE EVERYWHERE
W-K MFG. COMPANY So. W. Boulevard & Central St. Kansas City, Mo.

IMMEDIATE DELIVERY ON
Stemming and Tamping Bags

Write us giving size and quantity for immediate shipment. We carry a large stock of Seal-Tite Tamping bags of almost any size or quantity. Ask for a free sample and let us show you how our bags are seamed, sealed with special moisture proof glue preventing same opening.

Shots that are properly stemmed or tamped give greater fall per lbs. of explosive used.
We are specialists with years of experience and our seal-tite bags are in many of the world's largest mines. A money back guarantee if not satisfactory.

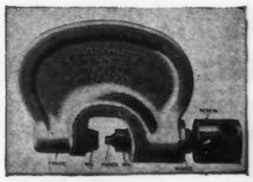
Bags of all kinds for the Mining Industry

The Tamping Bag Co., Mt. Vernon, Ill.

UMECO LIGHT WEIGHT TOOLS

One Man Can Bend Rails Speedily, Safely!

This UMECO Rail Bender is made of heat-tempered Aluminum—light in weight yet strong enough to handle the job *right!* One man can carry the Bender into any part of the mine, set it up with a simple "spin of the nut," and bend 30, 40, 60, or 80 pound rails with ease.



The UMECO Rail Punch shown at the left is also made of heat treated Aluminum and *one* man can punch a hole to hair-line accuracy in two minutes.

Write today for full information

UTILITY MINE EQUIPMENT CO.
620-30 Tower Grove Ave. St. Louis, Mo.

There is a *practical* solution to your problem of processing

CLAYS and FILTERING MEDIA

• Let our engineers work with you on your processing problem. Their wide experience with many diversified materials —in the laboratory and in the field—can be advantageously applied to clays and filtering media.

OR . . . .

to ROASTING, CALCINING and DRYING

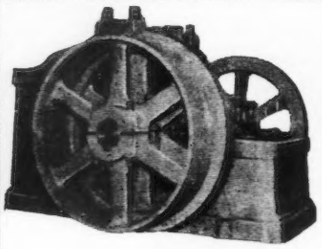
Lime Sludge
Sulphide Ores and Concentrates
Metal Slimes
Insulating Materials
Sewage Sludge
Quicksilver Ores
Pigments
Decolorizers, etc.
Chemical Salts

The flexibility and adaptability of the

NICHOLS HERRESCHOFF MULTIPLE HEARTH FURNACES

assure better operation and lower processing costs. Full details on request.

NICHOLS ENGINEERING & RESEARCH CORP.
40 Wall St., New York, N. Y.,
PACIFIC FOUNDRY COMPANY, LTD.
3100 19th St., San Francisco, Calif., U. S. A.



Complete Line of Dependable Mining Machinery

Jaw Crushers, Roll Crushers, General Mining Machinery. Many installations throughout the U.S.A. Write for details.

WEBB CITY and CARTERVILLE FOUNDRY and MACHINE WORKS
Est. 1894
WEBB CITY, MO.

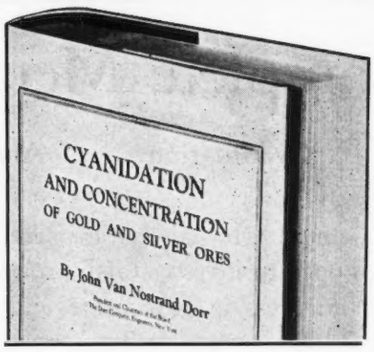
Sell that Equipment you no longer require

Advertise it in the

SEARCHLIGHT SECTION

for a quick sale and good return. Equipment you no longer require represents frozen assets. Liquidate it—get its value in cash!

GN1020



Just Published

A complete and detailed picture of the art of cyanidation as practiced today in the chief mining camps of the world.

CYANIDATION AND CONCENTRATION of Gold and Silver Ores

By John Van Nostrand Dorr
President, The Dorr Company, Engineers, New York

460 pages, 6 x 9, illustrated, $5.00

HERE is a complete and detailed picture of the art of cyanidation as practiced today in the chief mining camps of the world, with description of apparatus employed, flow-sheets used; and analyses of testing procedure, cost and operating data. More than 200 cyanide mill operators have aided in providing details upon which the thorough, authoritative treatment in this manual has been based.

Features of this book

—Contains flow-sheets in use at the present time.
—Includes test procedure and operating data received directly from contemporary plants.
—Discusses every typical ore, simple or complex, in any part of the world, with regard to treatment, and with examples from practice.
—Includes cost data from representative mills.
—Information and data never before published is made available through the contact of the Dorr Company with over 200 actual cyanide mill operators.

Here is a manual by which the operator or executive may check methods and improve results, in any part of his process, from examination of the ore to bullion recovery. The technical, economic and operating data of the industry, as it is being successfully carried on today, is placed before him in clear, usable form.

Examine this new book 10 days

SEND THIS COUPON

McGRAW-HILL ON-APPROVAL COUPON

McGraw-Hill Book Co., Inc., 330 W. 42nd St., N. Y. C.
Send Dorr's Cyanidation and Concentration of Gold and Silver Ores for 10 days' examination on approval. In 10 days I will send $5.00, plus a few cents postage and delivery, or return book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....
Address .....
City and State .....
Position .....
Company .....
(Books sent on approval in U. S. and Canada only.) J. 12-36

PREVENT SILICOSIS!

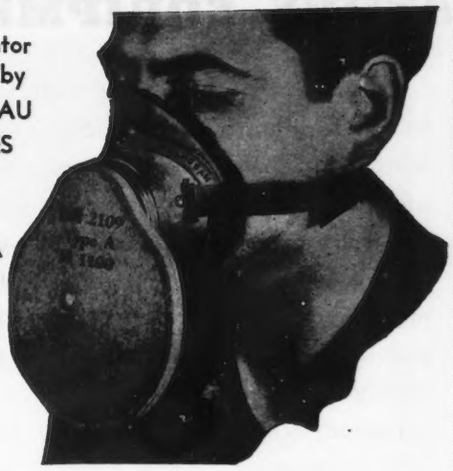
This respirator approved by U. S. BUREAU OF MINES

•

State of PENNSYLVANIA

•

State of WISCONSIN



Pulmosan M-1100 DUST RESPIRATOR

This respirator is officially approved for protection against fine silica-containing dusts in severe concentrations. When worn by miners, it is an effective preventive of silicosis. Light, comfortable, permits natural breathing, does not interfere with goggles or vision. All aluminum body holds shape, lasts long. Filter gives long service. *Write for full details.*

Pulmosan Safety Equipment Corp.

Dept. EM, 176 Johnson St., Brooklyn, N. Y.

1 to 50 Tons Capacity

Automatics!

(Dump 20 a minute without labor!)

The Quality of Our Wheels is Superb

(Try us on Repair Wheels or Trucks)

Other types of Ore Cars

Sanford-Day Iron Works, Knoxville, Tenn.

Here's the way it started...

and here's what happened

The Michigan Alkali Company made their first purchase of Cordeau-Bickford in June 1916. Quoting Mr. Bingham, the superintendent: . . . "we are perfectly satisfied with results obtained and have never considered going back to the old method of detonating with several electric blasting caps in each hole. We believe no other method is as dependable as Cordeau."

There is, naturally, a reason for the constantly increasing use of Cordeau-Bickford by progressive operators. They have found that distinct advantages offered by Cordeau result in greater efficiency, reduced costs, less hazard to the workmen and controlled fragmentation: important factors in every blasting operation.

Send for a copy of our Centennial Book and let us tell you more about Cordeau-Bickford.

BLASTING AT MICHIGAN ALKALI CO., ALPENA, MICH.

The following figures were supplied in connection with the blast which is shown being prepared in the above illustration:

Pounds of dynamite used	8,250
Number of holes	34
Average depth of holes	48 ft.
Distance back from face	18 ft.
Total length of blast	476 ft.
Cordeau fuse used	1,675 ft.
Tons of rock displaced (Limestone)	31,600

1836 · BEGINNING A NEW CENTURY · 1936 · ENSIGN-BICKFORD SAFETY FUSE ·

See also our Catalog in METAL QUARRY CATALOGS

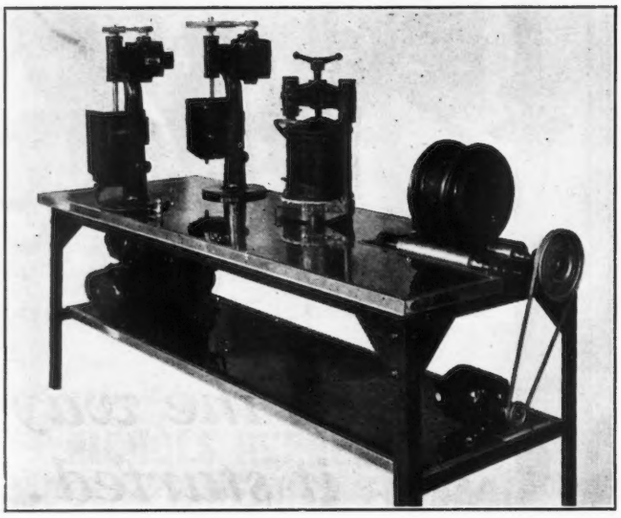
The ENSIGN-BICKFORD Company

Simsbury . . . . . Connecticut

SAFETY FUSE SINCE 1836

CB-57 ***Cordeau-Bickford Detonating Fuse***

THE BEST IN LABORATORY EQUIPMENT!



The Geco Testing Unit, illustrated, includes—Ball Mill; Conditioner; Flotation Machine; Sample Filter and all complementary equipment for flotation tests. Similar units are available for Gravity Concentration, Cyanidation and Amalgamation tests.

Samples of ore are being regularly received in our laboratories from countries all over the world, for the development of suitable treatment methods. The laboratory equipment we use every day for this important work must, of course, be the best. A large part of this equipment is of our own design, and all details to provide greatest utility, accuracy and dependability have been incorporated in the carefully prepared designs of individual testing units and combination testing units.

THIS SAME EQUIPMENT IS AVAILABLE FOR YOUR ORE TESTING LABORATORY. SEND YOUR INQUIRIES TO US AND WE WILL GLADLY SUBMIT LABORATORY LAY-OUT SUGGESTIONS.

THE GENERAL ENGINEERING CO., 159 Pierpont St., Salt Lake City

TORONTO - NEW YORK - LONDON

INTERNATIONAL SMELTING AND REFINING COMPANY

New York Office: 25 BROADWAY

ANACONDA
from mine to consumer.

Copper, Zinc and Lead

PLATINUM, PALLADIUM, TELLURIUM, SELENIUM, CADMIUM, COPPER SULPHATE

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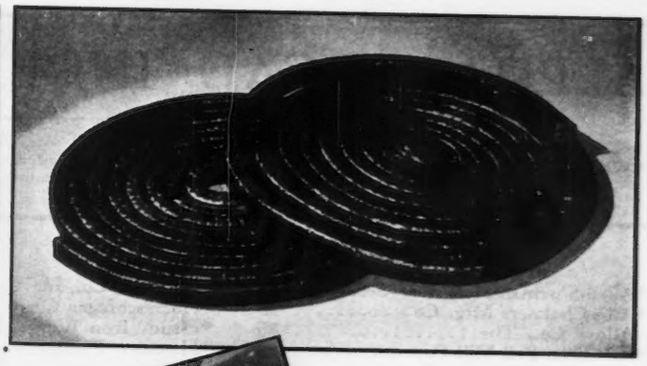

Above—GARLOCK 234 Coil
Left—GARLOCK 239 Rings

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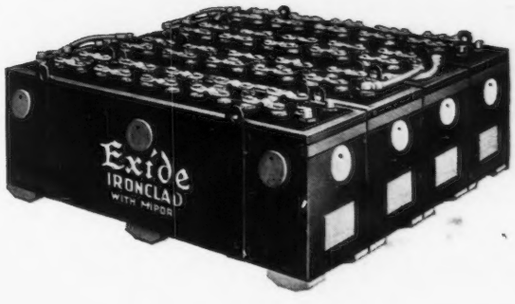

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